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Vol. XII November-December, 1949 No. 6

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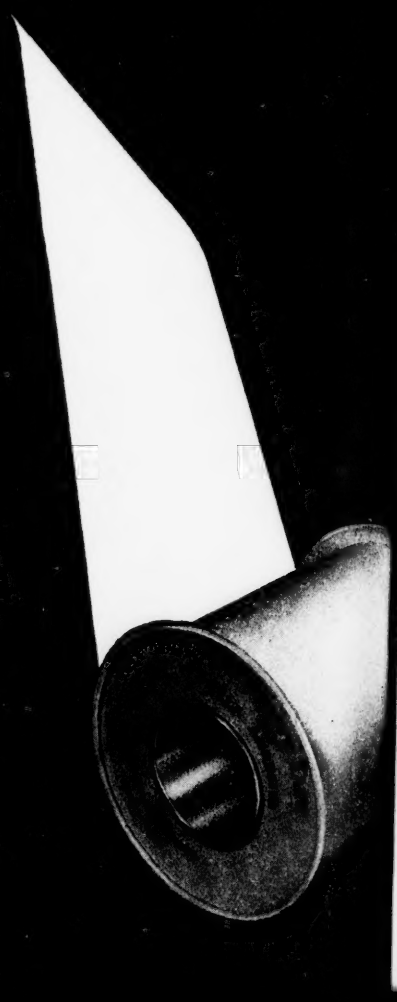

# The Journal of the International College of Surgeons

FOUNDED IN GENEVA, SWITZERLAND, 1935 - INCORPORATED IN WASHINGTON, D. C., 1940

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COLLEGE INTERNATIONAL DES CHIRURGIENS
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# The Journal of the International College of Surgeons

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Vol. XII NOVEMBER-DECEMBER, 1949 No. 6

## *Original Articles*

# Bilateral Vagal Resection, the New Approach to the Peptic Ulcer Problem

## Analysis of 100 Cases

R. L. SANDERS, M.D.
MEMPHIS, TENN.

IN VIEW of the vast amount of evidence of a psychic factor in the production and maintenance of peptic ulcer, it would appear that we have in bilateral vagal resection a weapon which, if rightly employed, attacks this disease at its source. Although identical in principle to gastroenterostomy and gastrectomy, vagal resection differs from both. Whereas gastroenterostomy merely circumvents gastric acidity and gastrectomy seeks to eliminate the acids by radical excision, in the interception of the nervous stimuli which control the activity of the parietal cells of the stomach this procedure represents an indirect approach to the problem.

The growing number of group case studies being reported is evidence of an increasing use of vagal resection and of serious efforts to estimate its early effects. Questions of the clinical benefits of the operation, their degree and duration within the period of observation, are clearly paramount. The secondary effects are, to a large extent, still obscure, yet sufficient time has elapsed in many cases to indicate their nature. In pursuance of efforts to evaluate this procedure from a clinical and physiologic standpoint, we are presenting a study of 100 vagal resections in our private practice.

In all these cases, transabdominal resection was employed. This approach seems to us preferable, in that one may thus visualize the disease process and determine its location, nature and extent, and, if necessary, may perform definitive surgery through the same incision. Not infrequently, other abdominal lesions which also require surgery are associated. Further, the patient's convalescence is shorter and more comfortable, and complications are fewer. Advocates of the transthoracic route report that all the nerves are more easily resected from above the diaphragm. This is not a serious consideration, however, as all the nerves are accessible and may be amply resected in more than 90 percent of the cases.

In using the abdominal approach, we have found it advantageous to leave the stomach

tube in situ as a guide. The esophagus is readily brought within reach if the left lobe of the liver is first mobilized by division of its triangular ligament. The peritoneum is incised over the lower end of the esophagus, the index finger is passed through the diaphragm, and the esophagus is completely freed from the margins of the hiatus opening and drawn down about three inches. The nerve trunks are thus placed under tension and may be isolated and sectioned with little or no difficulty. It is our custom to excise approximately 2½ inches of the nerves. Since the upper ends retract into the chest, regeneration seems unlikely. Before being dropped back into its normal position, the esophagus is explored all around with the finger to determine whether the trunks have been severed. The peritoneum in front of the esophagus is then closed with a few interrupted sutures of catgut.

In performing gastroenterostomy or gastrectomy in conjunction with vagal resection, the nerves should be sectioned first, while the hand is sterile; if the stomach is opened first, infection may be introduced into the mediastinum by the contaminated hand.

The 100 patients comprising this review were operated upon between Oct. 1, 1946, and April 1, 1948. These operations were performed for every type of ulcer except the acutely perforating and the massively bleeding during the actual hemorrhage. Two patients had perforating ulcers which were protected. In addition to the patients with duodenal ulcers, three had gastric and duodenal ulcers combined, and six had gastrojejunal lesions. Because of the possibility of malignancy, we have not employed gastroenterostomy with vagal resection for gastric ulcers. In seventy-seven of the cases of primary duodenal ulcer, a gastroenterostomy was performed, and in two a pyloroplasty. In three of the former, the gastroenterostomy was necessary as a secondary operation following vagal resection alone. Sixteen patients had a vagotomy without either gastroenterostomy or pyloroplasty; of these, the majority were performed in our early experience with the procedure.

In addition to the 100 patients of this study, we have performed vagal resection in 32 others, or a total of 132. Two of the additional 32 patients died too soon after operation to permit an estimate of the end results. One died of a cerebral thrombosis a few weeks after leaving the hospital, and the other succumbed to pneumonia five months postoperatively. Fourteen patients have been operated upon too recently for inclusion in this review. We have also performed either bilateral or unilateral vagal resection upon 16 patients who presented definite symptomatic and clinical evidence of peptic ulcer, yet, upon operation, were found to have only a duodenitis. This finding, incidentally, illustrates one advantage of the abdominal approach. Had the operations been performed through the thorax, the diagnosis of ulcer would have remained unquestioned.

We have classified the results in these 100 cases as (1) excellent, (2) good or fair, and (3) unsatisfactory or poor. The distinction has been difficult to make in some cases, though we have attempted to be conservative. The number in the first group, together with the operations, is shown in Table I.

TABLE I.

Operations in 79 Cases of Peptic Ulcer (Excellent Results)

| | |
|---|---|
| Vagal resection only | 8 |
| Vagal resection and gastroenterostomy | 66 |
| Vagal resection and pyloroplasty | 2 |
| Vagal resection and gastrectomy | 3 |
| 1 for gastrojejunal ulcer | |
| 2 for both duodenal and gastric ulcer | |

The patients in this group have been entirely free of pain since the operation, can take a normal diet, on the whole without distress, have a good appetite, have gained weight, and can carry on their usual duties without ill effect. A few continue to have some slight postprandial discomfort, particularly after breakfast, or an occasional mild flurry of diarrhea, but, by comparison with their former condition, the result may well be considered excellent. It is noteworthy that among this group were several who, during the first postoperative months, were believed to have an unsatisfactory result because of discomfort incident to poor emptying of the stomach.

In the majority of cases, however, gastric

motility has been good almost from the beginning and roentgenograms have shown evidence of healing of the ulcer within a few weeks after operation. In addition, a number of these patients were troubled with diarrhea early in their postoperative course, though this, also, subsided after a time.

One of these patients had persistent ulcer symptoms following vagal resection alone, and his acids remained high. Eight months postoperatively, the abdomen was reopened and it was found that all the nerve fibers had not been sectioned. The resection was completed and a gastroenterostomy made, and he has since had no difficulty.

It will be observed that only three other patients had a vagal resection alone for primary duodenal ulcer. All had considerable trouble with fullness for several months, but at present are experiencing little or no discomfort.

Another patient of this group had a massively bleeding gastrojejunal ulcer with almost complete obstruction of the stoma. The gastroenterostomy was disconnected and a gastrectomy was performed in addition to vagotomy. This patient, as well as the five who had a vagal resection alone for stomal ulcer, has remained entirely well.

We attribute much of the success of vagal resection in the remainder of these cases to the fact that a drainage operation was performed at the same time. The two patients who had a pyloroplasty had no cicatricial obstruction nor edema of consequence about the pylorus; hence, the outlet was simply enlarged. Under such circumstances, we believe pyloroplasty is preferable to gastroenterostomy.

Fifteen of the 100 patients were regarded as having a good or fair result, as shown in Table 2.

TABLE 2.

| Operations in 15 Cases of Peptic Ulcer (Good or Fair Results) | |
|---|---|
| Vagal resection only | 5 |
| Vagal resection and gastroenterostomy | 9 |
| Vagal resection and gastrectomy (For both duodenal and gastric ulcer) | 1 |

The postoperative complaints of patients in this group have consisted variously of mild nausea and fullness after meals, occasional eructations of bile and foul gas, weakness, a slight hunger sensation, and diarrhea. Only one patient complained of a hunger sensation, however; he had a vagal resection alone, and it is believed all the nerves were not sectioned. Roentgenograms have shown poor gastric motility. Also after vagotomy alone one other patient continues to have mild diarrhea in addition to moderately troublesome symptoms of decreased motility.

All of the five patients who had a vagal resection without a drainage operation still have some gastric retention, nausea, and belching of foul gas. Two probably will require a gastroenterostomy. Of those who had a gastroenterostomy in conjunction with vagotomy, three have some degree of atony, though two of the three have been operated upon fairly recently and may improve in time. The postoperative acids of all these patients, regardless of the type of operation, have been low or zero, both before and after insulin.

The patient who had a vagal resection and gastrectomy for duodenal and gastric ulcer continues to have some fullness and nausea. The roentgenogram, however, shows normal emptying of the stomach. It is our belief that his symptoms will eventually subside and he will obtain an excellent result.

It should be pointed out that all the patients in this group feel that, despite these mild or more or less transient disturbances, they have been materially improved by the operation.

The results in six cases have been unsatisfactory (Table 3).

TABLE 3

| Operations in 6 Cases of Peptic Ulcer (Unsatisfactory Results) | |
|---|---|
| Vagal resection only | 3 |
| Vagal resection and gastroenterostomy | 2 |
| Vagal resection and disconnection of gastroenterostomy | 1 |

Five of these patients had only a mild ulcer, or one which presented evidence of healing at the time of operation. The preoperative acids were only slightly or moderately elevated in three, yet all had every symptomatic and roentgenographic indication of an active

ulcer. One patient who had a gastroenterostomy and vagal resection combined still complains of nausea, vomiting, sour stomach and nervousness. We are at a loss to explain this condition, as his acids were zero following operation, and the roentgenogram showed evidence of healing of the ulcer. Another patient had a gastroenterostomy subsequent to vagal resection; he still complains of discomfort, now three months postoperatively, although the ulcer apparently has healed. We believe this patient is quite definitely of the neurotic type. One of those who had a vagal resection alone had a gastroenterostomy elsewhere more than a year later, but died of a cerebral hemorrhage a few days following the operation. Another was operated upon 17 months ago. We believe that all the nerves were not sectioned, as his acids have remained the same as before operation and he continues to have considerable distress.

The sixth patient had a gastrojejunal ulcer which had perforated and was protected. The gastroenterostomy was disconnected, the ulcer excised and a vagal resection was done. He was free of symptoms for almost one year; thereafter, his symptoms returned and he became extremely nervous. His fasting acids at this time were 10 and his postinsulin acids were 70. The roentgenogram showed normal emptying of the stoma and a deformity of the duodenal cap.

In 24 of the 100 patients the appendix was removed, either prophylactically or for an associated mild appendicitis. Nine patients had other major abdominal operations at the same time.

Eight patients had pulmonary complications following operation: seven had atelectasis and one had pneumonitis. In one, atelectasis was of massive degree, though in none of the others were these complications serious. At the first sign of atelectasis, it is our custom to return the patient to the bronchoscopy room and have a specialist thoroughly aspirate the bronchi. This brings prompt relief and, in some cases, may be a life-saving measure.

We have had no operative deaths in this series of cases, though one patient, previously mentioned, died after a subsequent operation elsewhere.

Insulin tests were obtained on only 42 of the 100 patients. Two who had an unsatisfactory result continued to have high acids following vagal resection alone. In 36, the fasting free acids were zero or within normal limits after operation, either by vagal resection alone or with a drainage procedure. One patient had only slightly elevated free acids preoperatively; following vagal resection and gastroenterostomy combined, they remained essentially unchanged. Another had lower fasting acids after operation, though his postinsulin acids were higher following operation than before. Both these patients have obtained excellent results.

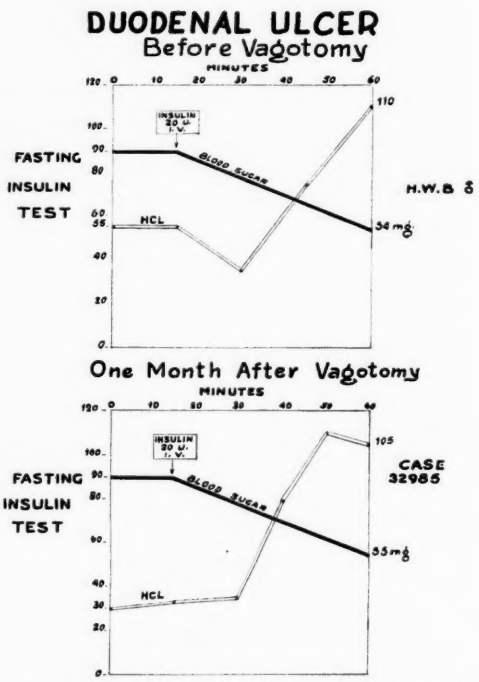


Fig. 1. Diagram showing an atypical curve in gastric acids under insulin hypoglycemia. Before vagal resection, the fasting acids were 55°, while one hour after the administration of insulin, the acids were 110°. The postoperative fasting acids were reduced to 30°, though the postinsulin curve reached 105°. This patient was one of those who obtained an excellent result.

No constant relationship has been observed between the preoperative acids and the surgical results. Four patients had free fasting acids well within normal limits before opera-

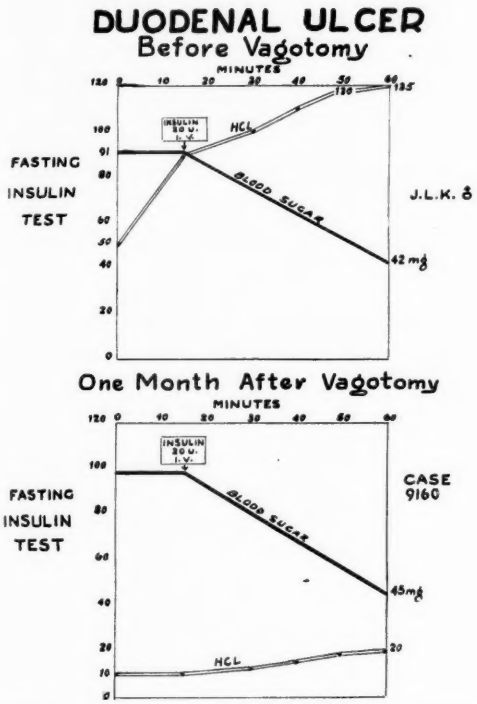


Fig. 2. This diagram shows typical results of insulin test before and after vagal resection. The preoperative fasting acids were 50°; one hour following insulin, the acids were 135°. It will be observed that the postoperative acids rose from 10° during fasting, to only 20° under the stimulus of insulin.

tion, yet they are among those who have obtained the most outstanding successes. All four had a gastroenterostomy. On the other hand, four whose results were unsatisfactory had only slightly elevated preoperative fasting acids. None of these patients had a gastroenterostomy.

Nor have we found any distinct parallelism between the reactions to insulin and motility following operation. Although a reduction of acidity was accompanied by decreased motility in a large proportion of the patients, a negative or low insulin curve was associated with normal motility in many, among them a few who had a vagotomy alone. These findings, moreover, were not peculiar to any one end result group, but were shown in all three.

We have also failed to demonstrate a consistent agreement between gastric motility and the symptomatic relief of these patients. The majority of those who obtained good or excellent results had a slightly or moderately decreased motility postoperatively. On the other hand, a similar roentgenographic picture was obtained in a few who had unsatisfactory results. In general, however, a material decrease in emptying time was accompanied by considerable fullness and distress.

Further, symptomatic improvement has not always been commensurate with signs of healing of the ulcer. In fact, in two patients whose results were unsatisfactory, the ulcers apparently healed after operation. Evidence of healing was observed in all those in the good and excellent result groups who had postoperative roentgenographic studies.

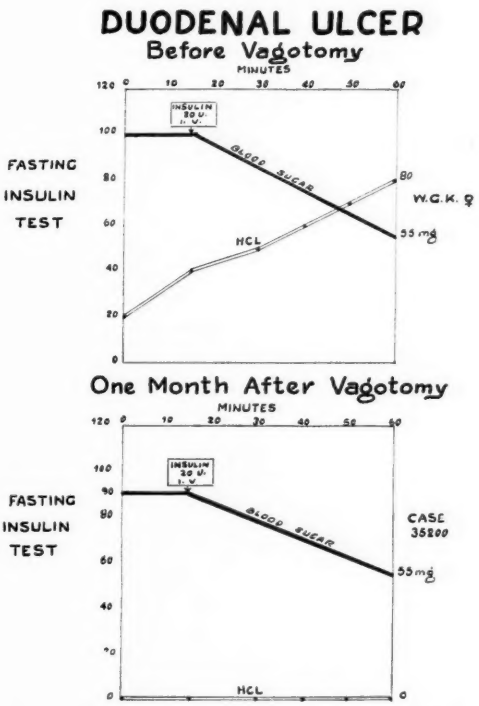


Fig. 3. In this case, the preoperative acids during fasting were 20°, but reached 80° after insulin. Following operation, the acids were zero, both before and after insulin. This patient also obtained an excellent result.

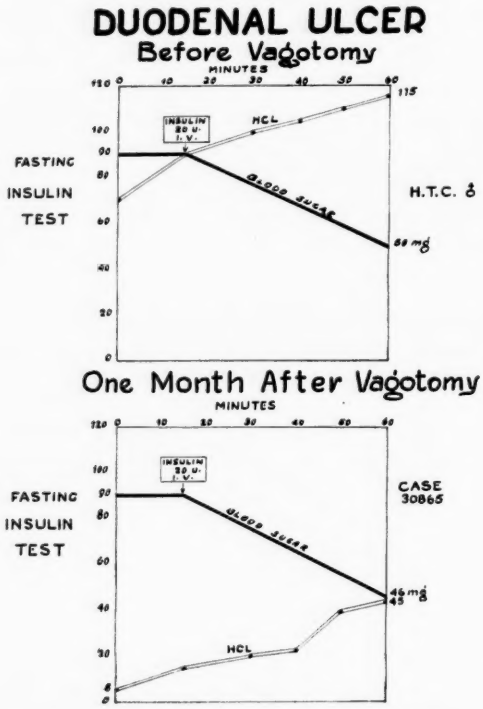


Fig. 4. Diagram showing acid curve of another patient who had an excellent result from vagal resection. The preoperative acids rose from a fasting of 70°, to 115° postinsulin. The fasting acids following operation were 5°, but reached 45° under insulin hypoglycemia.

One favorable effect, and one which has been a source of much gratification to these patients, has been the relief of constipation. Not infrequently, diarrhea proves troublesome during the early postoperative period, though this usually subsides and bowel function becomes normal within a short while. In only one of our patients, already mentioned, has an exception to this rule been encountered.

The most dramatic feature of vagal resection is the immediate cessation of pain. This alone generally justifies the operation in the opinion of the patients. Practically without exception, all those who complained of pain before operation have stated that they were free of pain upon awakening from the anesthetic. There is no doubt, moreover, that the relief of actual suffering has a salutary effect upon recovery.

In order to overcome gastric atony, it is our custom to leave the stomach tube in situ for three or four days after operation. In our early experience, a normal diet was permitted almost immediately following the operation. We found, however, that this practice was erroneous. After removal of the tube, we now place patients on a liquid diet for several days, and then on a soft and semisoft diet for a few weeks. Under this regime, gastric motility, if not adequate in the early postoperative period, usually becomes so within a reasonable time.

From observations thus far in these 100 cases, we feel justified in drawing several conclusions regarding vagal resection. In the first place, the procedure is most successful when performed for a definite, active ulcer. Otherwise, it cannot be relied upon to bring complete

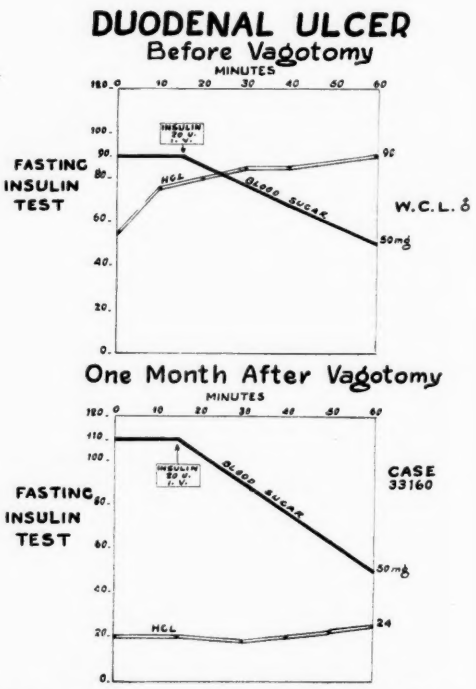


Fig. 5. In this case, the preoperative acids rose from 55° to 90°. Following vagal resection, the acids during fasting were 20°, and after insulin, 24°.

or lasting relief, even though the symptoms have been indisputably those of ulcer and the roentgenographic picture has substantiated this diagnosis. High preoperative acids add to the indication, yet are not essential. The surgical criteria having been fulfilled, the symptomatic response is, as a rule, excellent. In the typical case, relief of pain is accompanied by a slight or moderate gastric atony, low or negative acids, which remain essentially unaltered by insulin, and, within a few weeks or months, by healing of the ulcer. Any gastrointestinal disturbances, such as fullness and distress incident to retention, or diarrhea, tend to subside gradually. An unfavorable symptomatic and clinical response despite proper surgical indications is probably due either to a neurosis of the patient or to failure of the surgeon to resect all the nerve trunks.

The prospect for cure is materially better if the vagotomy is combined with a gastroenterostomy or pyloroplasty. We now add one of these procedures in every case except those wherein exploration reveals only a mild type of lesion without obstruction.

The safety and simplicity of vagal resection, particularly when performed through the abdomen, and its advantages over gastrectomy are sufficient to commend it for an exhaustive trial. Our experience thus far leads us to believe that, for patients with definite ulcer, it holds a bright promise; in fact, the high praise of these patients themselves is the most convincing argument in behalf of the procedure.

## SUMMARY

1. If our conception of a psychic factor in the causation and maintenance of duodenal ulcer is correct, treatment of this disease by interruption of the nervous stimuli which control acid secretion and motility of the stomach would seem to have a sound physiologic basis.

2. In an effort to further an evaluation of bilateral vagal resection, 100 private cases are reviewed. These include gastrojejunal ulcers, as well as intractable, obstructive and bleeding duodenal ulcers. In the majority, a gastroenterostomy was combined with vagal resection, and in two a pyloroplasty was performed.

3. The abdominal approach was consistently employed. This method permits ample resection of the nerves, provided the left lobe of the liver is first mobilized. In our opinion, the abdominal route is preferable to the transthoracic, in that the disease process may be visualized and, if indicated, definitive surgery may be performed through the same incision. Further, convalescence is smoother and more comfortable, and complications are less likely to develop.

4. Of the 100 patients comprising this review, 79 have obtained an excellent result, with complete or almost complete relief of symptoms. Fifteen have good or fair results, continuing to experience some disturbance chiefly attributable to gastric atony. Six have thus far been only slightly benefited. The outcome in five of the latter is largely explained by the fact that the ulcers were mild in type, though in one of these the vagal resection was probably inadequate and another had an ulcer neurosis.

5. Analysis of these groups indicates that bilateral vagal resection is most suitable for clear-cut, active ulcers, preferably, though not necessarily associated with high free acids. In such cases, pain should be relieved immediately and digestive disturbances should promptly or gradually subside as gastric tonus is restored. In the typical case, the post-operative acids are low, even after the injection of insulin, and there is evidence of healing of the ulcer within a few weeks or months. We believe the prospect for cure is far more favorable if a pyloroplasty or gastroenterostomy is perfomed in conjunction with vagal resection.

## RIASSUNTO

1. Se il concetto di un fattore psichico nell'etiologia dell'ulcera dudodenale e' corretto, l'interruzione degli stimoli nervosi che controllano la secrezione dell'acido cloridrico e la motilità dello stomaco offre la migliore base fisiopatologica d'impostazione per la cura di questa malattia.

2. Cento casi di ulceri gastro-duodenali, di ulceri duodenali stenosanti od emorragiche, vengono passati in rassegna onde valutare meglio i risultati della vagotomia bilaterale. Nella maggioranza di questi casi la resezione

vagale e' stata associata alla gastro-enterostomia: in due casi e' stata eseguita una plastica del piloro.

3. L'A. ha sempre preferito ricorrere alla via addominale, la quale consente un'ampia resezione dei nervi dopo mobilizzazione preliminare del lobo sinistro del fegato. La via addominale e' preferibile alla via transtoracica anzitutto perchè la prima consente una perfetta visione e valutazione clinica dell'ulcera e con ciò la possibilità di eseguire operazioni complementari con una sola incisione: in secondo luogo perchè la convalescenza e' più rapida, meno esposta a complicazioni.

4. In 79 casi i risultati sono stati eccellenti, con una completa o quasi completa cessazioni dei sintomi. In 15 casi i risultati sono stati buoni o discreti, con qualche lieve disturbo residuole, dovuto per lo più ad atonia gastrica. In 6 casi i risultati sono stati nulli o quasi.

5. L'analisis di questa statistica dimostra che la vagotomia è particolarmente indicata per le ulceri attive, a stampo, preferibilmente ma non necessariamente associate ad un'alta percentuale di acido cloridrico libero. In questa categoria di ulceri i dolori dovrebbero cessare rapidamente o gradatamente man mano che il tono dello stomaco si ristabilisce. Nei casi tipici i valori dell'acido cloridrico si mantengono—anche con la prova dell'insulina-bassi, mentre la guarigione dell'ulcera si manifesta clinicamente a distanza di alcune settimane al massimo a distanza di pochi mesi.

L'A. conclude dichiarandosi convinto che la probabilità un completo e definitivo successo viene notevolmente accresciuta dall'associazione con una piloroplastica o con una gastro-entero-stomia.

SUMARIO

1. Si nuestros conceptos modernos de factores psiquicos en la genesis de la ulcera duodenal es correcto, su tratamiento por la vagotomia es fisiologicamente logico.

2. Se han analizado los resultados de la vagotomia bilateral en 100 casos de pacientes de paga. Se han incluido ulceras gastroyeyunales, asi como ulceras duodenales intractables, con obstruccion y complicadas por la hemorragia. En la mayoria de los casos se practico la gastroenterotomia con la vagotomia bilateral; dos casos fueron tratados por la piloroplastia.

3. Consistentemente usamos la via abdominal, por cuanto permite mejor reseccion de los nervios, siempre y cuando se mobilice previamente el lobo izquierdo del higado. En nuestra opinion la via abdominal es preferible a la via transtoracica, por cuanto permite mejor visualizacion del proceso patologico y si esto lo indica, se puede practicar otros procedimientos quirurpicos por la misma incision. Aun mas, la convalesencia ofrece menos contratiempos para el paciente, por cuanto hay menos posibilidades de complicaciones post-operatorias.

4. 79% de los pacientes en esta serie han tenido resultados excelentes, con completo, o casi completo alivido de todo sintoma de la enfermedad. Un 15% han presentado buenos resultados, y aparentemente solo sufren de sintomas residuales debidos especialmente a la atonia gastrica resultan te Solo seis de los pacientes han recibido muy poco beneficio. De estos seis, cinco sufrieron de una ulcera muy benigna y en uno de ellos la reseccion del nervio fue probablemente inadecuada; y en otro la falta de alivio se debe en gran parte a que el paciente sufria de una neurosis intensa.

5. Analisis de estos grupos indica que la reseccion bilateral del nervio vago es el metodo de seleccion en los casos de ulceras activas, preferentemente, de ulceras con acides alta. En estos casos, el dolor se alivia inmediatamente y los desarreglos digestivos desaparecen con la reaparicion del tono gastrico normal. En los casos tipicos la acides es generalmente baja, aun despues de la insulina, y hay evidencia de cicatrizacion le la ulcera dentro de unas poces semanas o meses. Creemos que las posibilidades de la curacion incrementan si se combina la piloroplastia, o la gastro-enterostomia con la vagotomia.

SOMMAIRE

1)—Si notre conception d'un facteur psychique dans l'étiologie et le maintien de l'ulcère duodènal est correcte, le traitement de cette maladie par l'interruption des excitant-

nerveux qui contrôlent la secrétion acide et la motilité de l'estomac, paraîtrait avoir une base physiologique solide.

2)—Dans nos efforts pour déterminer la valeur de la résection bilatérale du vague, nous passons en revue 100 cas de clientèle personnelle. Il est inclus des ulcères gastro-jèjunaux et des ulcères duodénaux occlusifs persistants et hémorragiques. Dans la majorité des cas, nous fîmes une gastro-entérostomie combineé a une résection du vague et dans deux cas nous fîmes une pyloroplastie.

3)—La voie abdominale fût employeé dans tous les cas. Cette voie permet une résection suffisante des nerfs, pourvu que le lobe gauche du foie soit immobilisé. Nuus sommes i'avis que la voie abdominale est preférable à la voie transthoracique car ainsi les lésions sont mieux exposées et opération définitive si eue est, indiquée, peut être faite par la même incision. En plus, la convalescence moins agitée est plus confortable et les complications surviennent moins souvent.

4)—Sur 100 malades inclus dans cette serie, 79 obtinrent un excellent résultat avec une remission compléteous presque complète des symptômes; 15 eurent de bons résultats quoiqu'il persistat quelques troubles dûs principalement a l'atonie gastrique; 6 de ces derniers cas ne benéficièrent que légèrement de la therubuchique. Dans five de ces cas, l'ulcère était peu, étendu; dans un cas, la résection du vague fut probablement non inidiquee et dans un autre cas, nous avions à faire a une névrose compliquant l'ulcère.

5)—L'analyse de ces groupes indique que la résection bilatérale du vague donne de bons résultats surtout dans les cas d'ulcères actifs, presentant ou non une haute hypéracidité. Dans ces cas, les malades devraient être soulagées immediatement et les troubles digestifs devraient disparaitre à mesure que le tonus gastrique se rétablit. Dans le cas typique, l'acidité post-opératoire est basse même apres l'injection d'insuline; on constate la guérison de l'ulcére dans quelques semaines ou mois quelques. Nous sommes d'avis que la guérison de l'ulcère est beaucoup plus friquente quand une plyoroplastie ou gastroentérostomie est faite correlativement a la résection du vague.

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# Concept of Gastroduodenal Ulcerogenic Disease

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SINCE 1830, when Cruvelhier brought the attention of the medical world to the existence of gastric ulcer, this name has been adopted unanimously to designate a pathologic entity which, following a complicated mechanism (well known in our day), is the cause of ulcerations of the gastric and duodenal mucosae.

The appearance of the anatomic injury attracted the attention of all surgeons and clinical investigators, and its aspect, characteristics, and complications were described in full.

It is undeniable that the ulcer or anatomic injury is more peculiarly characteristic, gave its name to the affection, and therefore the notion of "ulcerous illness" was conceived.

Clinical and roentgen examination of the patient, together with functional study of the gastric secretion, makes possible an easy and accurate diagnosis in the majority of cases. The clinician applies medical treatment; if the patient does not notice any important improvement in his ailment (which requires the adoption of a permanent dietetic and hygienic regimen) a surgeon is called in to solve his difficulties. The patient is then submitted to an operation. In most cases the ulcer is detected and surgical intervention takes place in accordance with the technic indicated in the particular case.

In many instances however, the diagnosis of duodenal ulcer is made by the best clinicians and roentgenologists, and yet the anatomic injury does not appear. In such cases, analysis of the gastric juice gives sufficient coincident information to confirm the existence of the ulcer. The fact that the ulcer does not appear at operation is attributed to incorrect diagnosis, but, in spite of its nonappearance some surgeons perform gastrectomy. Others, more prudent, prefer to close the abdomen and prescribe continued medical treatment. Naturally the patient continues to suffer, and after a more or less prolonged interval, is submitted to another operation. Only then is an ulcer (which in the first operation was not visible) observed, now fully apparent. In my opinion, this situation is explained as follows: Owing to various factors, especially factors of psychic origin, the patient suffers at first from exaggerated vagal stimulation, consequently, hypersecretion and hyperquilia (hyperacidity) appear, mainly in the guise of nocturnal permanent secretion in any empty stomach.

Chlorhydric acid when present in abnormal amounts, has an irritating action on the gastric mucosa, intensified by prolonged contact with the same, without being diluted in the food taken as nourishment and especially in the liquids. As a result, a permanent irritation of the mucosa is observed in the ulcerous patient, and the condition has been designated in a general way as "gastroduodenitis". This irritating effect on the gastric mucosa may be complicated later on by the presence of bacteria, which aggravate the inflammatory symptoms. Symptoms of irritation and inflammation are constantly observed in the affected persons, and their presence constitutes the typical clinical ulcerous ailment, in which pain is felt rhythmically during the day in relation to the meals; this rhythmic tendency persists the entire year according to the evolution of the disease and under the considerable influence of the economic and moral status of the patient.

The complaint is undoubtedly a psychosomatic illness.

The persistence of hypersecretion and hyperquilia (hyperacidity) is the cause of gastroduodenitis, consequently the defensive or protective resistance of the duodenal mucosa is weakened, favoring thus the formation of the familiar known ulcerations. Later on other well known complications, such as perforations, hemorrhages and degenerations, may appear, completing the evolution of the illness.

The illness develops in four periods: (1) Hypersecretion and hyperacidity; (2) gastroduodenitis; (3) ulceration; and (4) complications.

If the evolution of the illness is closely followed, it is evident that in the first two periods no ulcers appear, and yet the illness exists. It is all a question of time, and of aggravation of the disease. The ulcers will eventually appear. So long as they do not appear, however, the disease cannot be described as ulcerous. Still less can the term "duodenal ulcer" be properly applied, for it would be paradoxical to speak of an "ulcerous illness" when no ulcers exist.

In my opinion, the illness must always be called "ulcerogenic". This conveys the idea that ulcers appear only in a more advanced stage of the disease. It should be noted that in "ulcerogenic" illness there are also two different periods: the first, in which functional phenomena predominate and anatomic injuries are scarce; and the second in which ulcers and their complications appear in full evidence. The first period of the illness could be termed "pre-ulcerous", leaving the denomination "ulcerous" for the second.

From these data it is obvious that gastrectomy performed in the pre-ulcerous period is unwise. In my own experience, when no definite healing or improvement is gained by medical treatment, the procedure of choice is vagotomy complemented by pyloroplasty.

For the period when the ulcer appears in full evidence, leaving no doubt as to its presence or its complications, my experience, accumulated over a great many years, leads me to advise subtotal gastrectomy as the most appropriate operation.

SUMMARY

The gastroduodenal ulcer constitutes the final stage of an illness in which the initial period is characterized by functional troubles, but in which ulcerations do not appear. This fact should be taken into consideration and the entity described as "ulcerogenic" instead of "ulcerous", the term generally used.

The ulcerogenic illness develops in several stages, among which the first two periods are noted by nonexistence of ulcerations.

RIASSUNTO

L'ulcera gastro-duodenale rappresente l'ultima fase di una malattia, di cui la fase iniziale è caratterizzata semplicemente da disturbi funzionali. Il complesso della malattia—che l'A. definisce ulcerogenica—puo' essere suddivisa in parecchie tappe: è interessanfe notare come le prime due siano ancora esenti da ulceri.

SUMARIO

La ulcera gastro-duodenal constituye la etapa final de una enfermedad cuyo periodo inicial esta caracterizado por desarreglos funcionales, pero sin ulceracion. Este hecho debe de tomarse en consideracion y la entidad debe de describirse como "ulcerogenica" en lugar del termino "ulcerosa" que es el que generalmente se usa.

La enfermedad ulcerogenica se desarroya en varias etapas, pero sus dos peridos primeros se caracterizan por la falta de ulceraciones.

SOMMAIRE

L'ulcère gastraduodénal constitue la dernière phase de la maladie dans laquelle la période initiale est caractérisée par des troubles fonctionnels mais dans laquella l'ulcération n'existe pas. Il faut prendre en considération ce fait et l'etat doit être décrit comme ulcérogénique et non comme ulcéreux, terme employé généralement. La maladie ulcérogénique se développe en plusieurs temps; dans les deux premières périodes, il n'y a pas d'ulcération.

# Spontaneous Pneumoperitoneum—Diagnostic Significance

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IN THE progress of medicine through the centuries, individual discoveries stand as beacons, lighting the way for the reduction of mortality in acute abdominal disease. The discovery of the x-ray by Roentgen in 1895, provided a means of observing the internal anatomic structures and their functions in the normal or the pathologic state.

However, it was not until 1915 that Popper[1] noted the following correlation: during fluroscopy he observed a sickle shaped zone of radiolucence between the right diaphragm and the upper lobe of the liver in a patient who eight days previously had presented the clinical symptoms of an acute perforation of a peptic ulcer. In the following year, Lenk,[2] a military surgeon, emphasized the significance of intraperitoneal free air in his x-ray findings of abdominal gun shot wounds.

During the ensuing nine years relatively few reports on spontaneous pneumoperitoneum were published. Single cases were reported by Weil,[3] Martin,[4] Kellogg,[5] Dandy[6] and others until a total of 17 accumulated. The first published series of any appreciable number was in 1924 by Vaughan and Brams.[7] In their group, pneumoperitoneum was present in 13 of 15 anatomically proven cases of perforated ulcer.

Pneumoperitoneum may occur spontaneously or may be induced for diagnostic and therapeutic measures. The spontaneous type which occurs with perforation of a hollow viscus is of chief interest in surgical diagnosis.

In our opinion, the spontaneous type may be divided into the *immediate* and the *delayed* forms. In the immediate form, free air which shifts with the patient in different positions is present. The free air within minutes, or a few hours at the most, follows the perforation of a hollow viscus. The most frequent predisposing causes for its occurrence are (Fig. 1):

1. Acute perforation of a gastric or duodenal ulcer.
2. Perforating gun shot or stab wounds of the stomach or intestine.
3. Perforation of a "forme fruste" peptic ulcer.
4. Perforation of a neoplasm of the stomach or intestine.
5. Perforation of an appendix at its base.
6. Perforation of a diverticulum, usually of the left colon.
7. Perforation due to severe blunt trauma to the abdomen.
8. Perforation of the intestinal tract following the ingestion or introduction of foreign bodies.

Other less frequent causes are:

1. Perforation of the intraperitoneal urinary bladder.
2. Perforation of a tuberculous or typhoid ulcer.
3. Perforation during chronic ulcerative colitis.
4. Perforation due to immersion blast injuries.
5. Perforation during gastroscopic examination.
6. Rupture of a distended loop of bowel following a partial or complete obstruction.
7. Perforation of a gangrenous Meckel's diverticulum.
8. Perforation of pneumatosis cystoides intestinalis.

The delayed form manifests itself days or weeks after the occurrence of the initial process. Roentgenologically, the delayed form does not alter its site in the abdomen with change in position of the patient, although the fluid level may shift. This form usually presents itself as an intra-abdominal abscess with a collection of purulent material and by the

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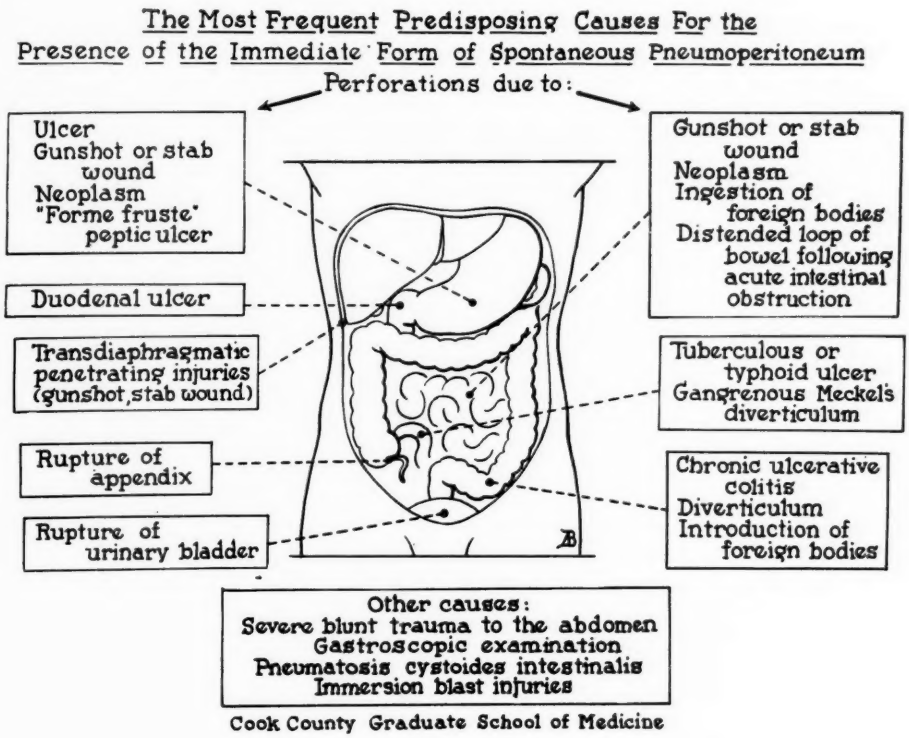



Fig. 1.

action of E. Coli, alone, or in combination with anerobic staphylococci or streptococci. These organisms produce gas that is demonstrable roentgenologically as free air. This form is a secondary condition that is present in cases of: subphrenic abscess; peridiverticulitis with abscess; pericholecystic abscess; acute appendicitis with perforation and perforation of a neoplasm into a previous localized inflammatory zone (Figs. 2, 3, 4, 5).

The exact localization of the abscess in this group is of paramount surgical importance, since a knowledge of its anatomical relationship determines whether an intraperitoneal or extraperitoneal approach will be the most favorable for drainage. Beck, Koucky and Baker[8] have emphasized the value of roentgenological examination of the abdomen for the localization of abscesses.

The amount of air that must escape in order to be visible was investigated by Paine and Rigler.[9] They found that a quantity as little as five cubic centimeters in the right subphrenic space could be visualized fluoroscopically or on the x-ray film. Ten cubic centimeters can be seen regularly without difficulty (Figs. 6, 7, 8).

The incidence of spontaneous pneumoperitoneum following acute perforation is greatest in lesions of the stomach and colon. Normally in adults no air is present within the small intestine; however, the lumen of the small intestine of infants and children up to the age of three will, often as a normal finding, reveal air. This results from the swallowing of air and the partial incompetence of the pyloric sphincter. Spontaneous pneumoperitoneum in perforative lesions of the small intestine may not be revealed for a period of several hours following rupture. With ileus and secondary gas formation, free air may be demonstrated by repeated fluoroscopic examination.

Poer and Woliver[10] reported 36 cases with perforation of the gastro-intestinal tract and

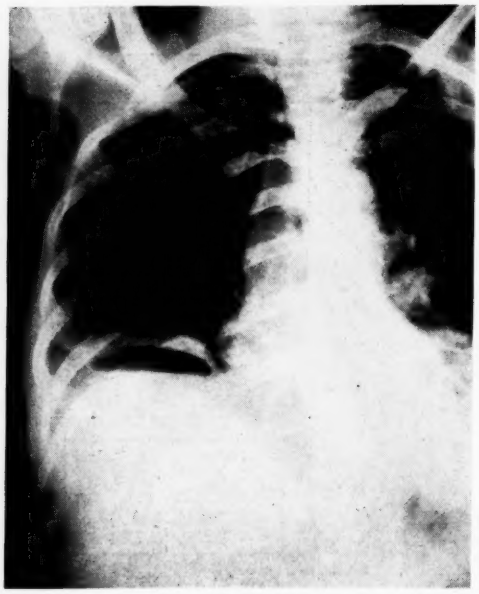


Fig. 2. Roentgenogram showing the anterior-posterior view of a right subphrenic abscess.

stated, "evidences of free fluid or gas within the peritoneal cavity were rare." Unfortunately, they do not mention the number or type of cases which were investigated for the presence of free air. Estes,[11] in their paper advised that roentgenograms be taken for the demonstration of subdiaphragmatic free air. If it is negative, the possibility of intestinal rupture should not be eliminated. On the other hand, Ficarra,[12] in reporting 18 cases of traumatic perforation of the small intestine which were observed at the King's County hospital, said that in 11 patients who were fluoroscoped, six patients or 54.5 percent showed evidence of spontaneous pneumoperitoneum.

The presence of a rigid abdomen and tenderness are not pathognomonic of a perforative lesion of a hollow viscus, for it's well known that such findings are common in non-perforating conditions. We would like to cite a summary of the history in a child who clinically presented the problem of differential diagnosis between traumatic rupture of the intestine, rupture of the spleen or rupture of the kidney.

CASE REPORTS

*Case 1:* Male, age seven, was admitted to the pediatric surgical service of the Cook County hospital, Aug. 7, 1947 with the history of having been accidentally struck in the epigastrium with a baseball bat and who on physical examination showed all the classical clinical findings of an acute abdomen. On fluoroscopic examination, a minute amount of free air was present in the right subphrenic space which shifted upon changing the patient to the left lateral decubitus position (Figs. 9, 10). Laparotomy was performed and a perforation of the terminal ileum, one centimeter in diameter closed.

The importance of spontaneous pneumoperitoneum to the clinician and surgeon cannot be over-emphasized for invariably it indicates the perforation of a hollow viscus. The exceptions to this are an artificial pneumoperitoneum, tubal insulfation, recent laparotomy and the occasional case of a perforation that

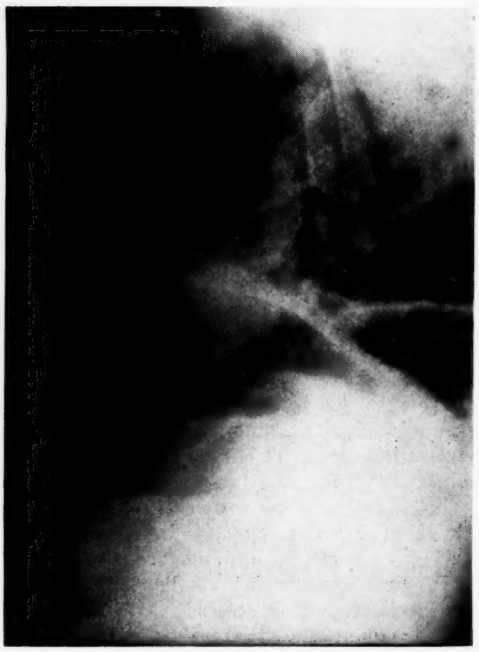


Fig. 3. Roentgenogram showing lateral view of a bilateral subphrenic abscess.

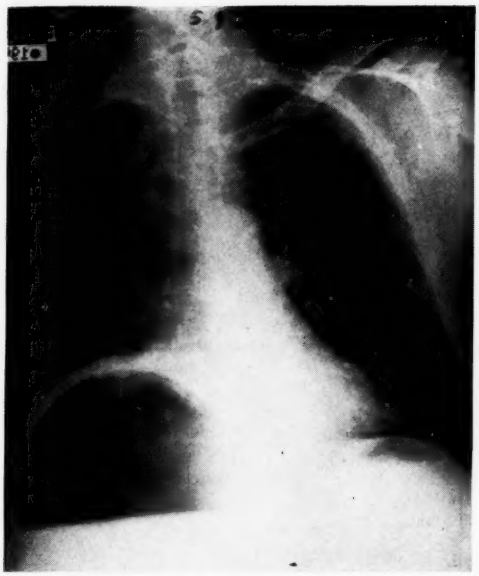


Fig. 4. A-P view of a right subphrenic abscess showing the fluid level and air. From a patient with a perforated appendix who developed this abscess two weeks later.

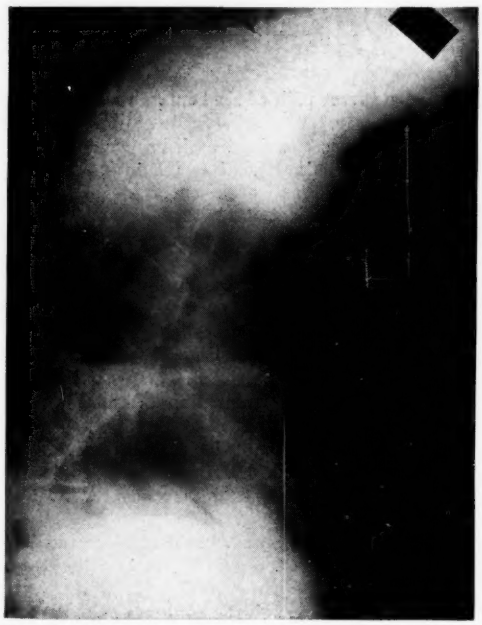


Fig. 5. Lateral view of the same patient as in Fig. 4.

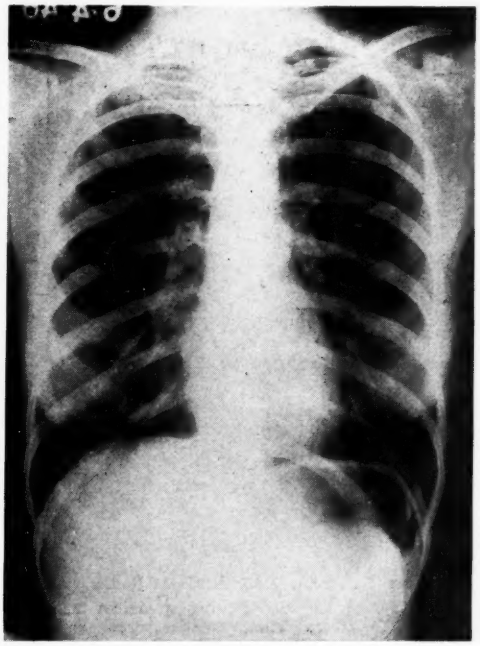


Fig. 6. Roentgenogram showing a minimal amount of free air in the right subphrenic space.

seals itself almost instantly as in the "forme fruste" peptic ulcer. Schindler[13] has reported eight cases of apparent perforation during gastroscopic examination which are manifested by the radiographic demonstration of free air, but on exploratory laparotomy no perforation could be found. European literature mentions the condition of pneumatosis cystoides intestinalis, wherein small cysts that form beneath the serosa of the intestine may rupture and give rise to a pneumoperitoneum. However, this has not been reported in American literature.

The greatest diagnostic aid, derived from spontaneous pneumoperitoneum, is in the case of acute perforation of a peptic ulcer. Here the positive findings are present in 80 to 85 percent of the cases. No one should experience any difficulty in making the diagnosis when the classical symptoms and physical findings are present. In a certain percentage of patients, the essential physical pathological findings of tenderness, rigidity and rebound

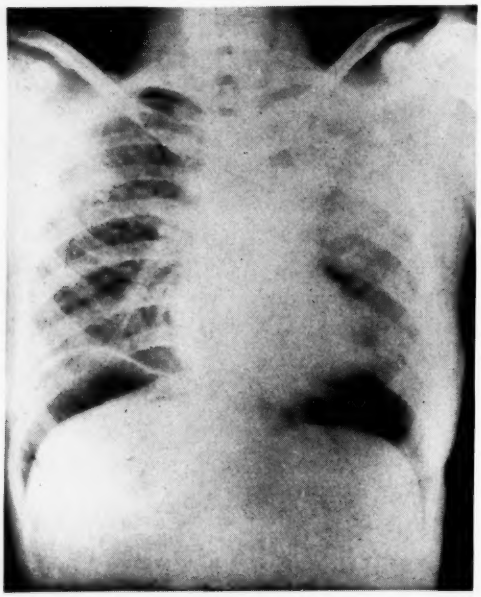


Fig. 7. Roentgenogram showing maximum free air in the right subphrenic space.

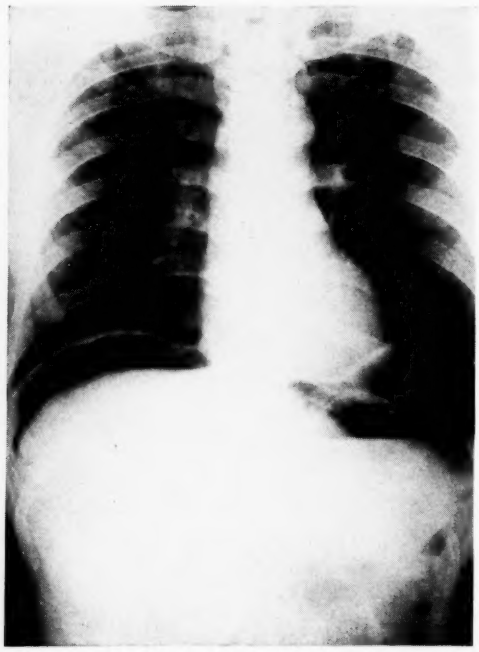


Fig. 8. Roentgenogram showing maximum free air in both subphrenic spaces. Note the fluid level in the stomach.

will be limited to the right lower quadrant; this results from the gravitation of the fluid of the epigastrium down the right colic gutter to the right iliac fossa and clinically simulates acute appendicitis.

In reviewing 400 cases of acutely perforated peptic ulcer operated upon by members of the surgical staff of the Cook County Hospital, it was found that of the 250 patients who were fluoroscoped, spontaneous pneumoperitoneum was present in 205 or 82 percent. A right lower gridiron incision was made in two percent of the patients. On opening the peritoneal cavity the typical "dish water" fluid was found and then it became apparent that the pathology was located in the stomach or the first portion of the duodenum. The late Lord Moynihan[14] reported that of 49 cases of acutely perforated peptic ulcer operated by him, in 18 the incision was made first over the appendix. This is illustrated in the following case history.

*Case 2:* Male, colored, age 21, was admitted Aug. 4, 1947 to the Cook County hospital, (surgical service of Dr. J. B. O'Donoghue) with a history of sudden severe pain of six hours' duration, in the lower abdomen.

The pain was described as being sharp and of great intensity. Shortly after its onset, the pain radiated over the entire abdomen. At the time of admission, the patient stated that most of the pain was in his right lower abdomen.

On physical examination the temperature was 100 F., pulse rate 96, respirations 18 and blood pressure 128/86. The abdomen was scaphoid and diffusely tender. Definite localized rigidity of the right lower quadrant with marked tenderness over McBurney's point was present. The psoas sign was positive. On rectal examination bilateral tenderness anteriorly was present.

Examination of the urine was negative. The leukocytes numbered 8800 per cubic millimeter with a preponderance of polymorphonuclears. A diagnosis of acute appendicitis was made and the abdomen opened through a right gridiron incision. The appendix and terminal ileum appeared normal. Fluid, best described as "dish water," was present and after aspiration more would appear. The wound was closed and a right paramedian in-

cision was made which revealed a perforated duodenal ulcer.

Perforation of a duodenal ulcer often gives the physical findings of a localized right sided peritonitis, whereas a perforation of a gastric ulcer or neoplasm may give the physical findings of a diffuse peritonitis (Fig. 11).

To illustrate the manner in which the presence of a pneumoperitoneum comes to the rescue in making an otherwise difficult diagnosis, the following history is cited.

*Case 3:* Male, white, age 61, was admitted to the Cook County Hospital, Aug. 8, 1947 with epigastric pain, left shoulder pain and diarrhea of 12 hours' duration. The pain which was of moderate

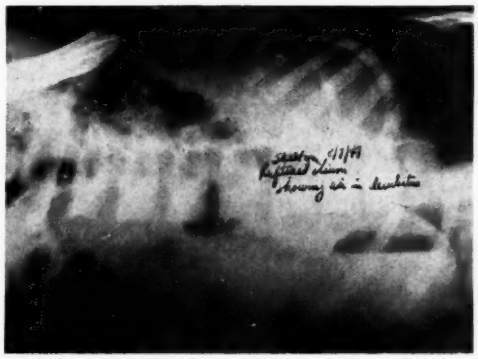


Fig. 10. Roentgenogram taken in the left lateral decubitus position showing the presence of free air.

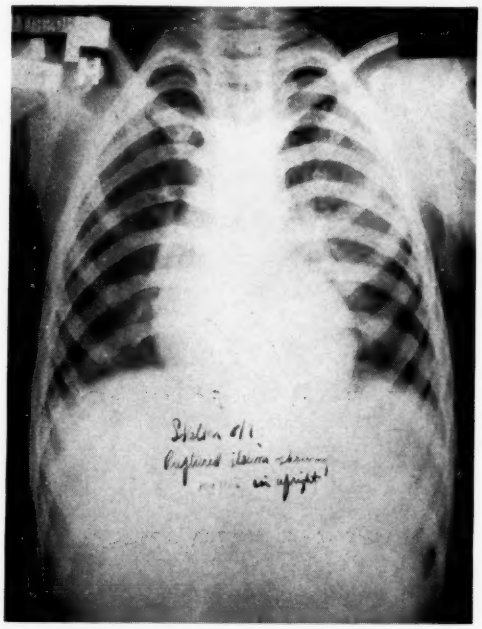


Fig. 9. Roentgenogram showing a minute amount of free air in the right subphrenic space.

intensity at its onset had diminished somewhat when admitted. His past history included a venereal disease, 25 years ago.

On physical examination the temperature was 101.4 F., pulse rate 104, respirations 30 and blood pressure 100/60. The abdomen was soft and non tender. The peristaltic sounds were normal. On percussion the liver dullness was obliterated.

Because of the obliterated liver dullness and the sudden onset of epigastric pain, the surgical resident requested a roentgenogram for the presence of free air. This was positive (Fig. 12).

Reexamination showed Argyll-Robertson pupils and absence of the deep reflexes. Laparotomy was performed and a perforated duodenal ulcer closed.

Another group of patients in whom spontaneous pneumoperitoneum may be demonstrated frequently, are those who have the complication of a perforated neoplasm. Mayo, Dixon, Rankin and others have found that perforation occurs in approximately 10 percent of gastro-intestinal neoplasms, either at the site, or at a point proximal to the growth. Our experience has been similar. In the great majority of these patients wherein an atypical history and atypical physical findings were presented, the x-ray is an invaluable aid in the solution of this diagnostic problem.

Recently we observed two patients in our surgical ward, one with a carcinoma of the rectosigmoid that perforated at the cecum, with the presence of spontaneous pneumoperitoneum, the other patient with a carcinoma of the transverse colon which perforated through a diverticulum located proximal to the neoplasm (Fig. 13, 14, 15, 16).

It is our opinion that in acute obstruction of the left colon, with the dilating ability of the cecum and the presence of a functioning ileo-cecal valve, the pressure per unit area is greater on the cecum than any other place in the colon and hence the reason for rupture taking place in the cecum.

Let us emphasize that one should not depend upon fluoroscopy itself for the demonstration of pneumoperitoneum, but have a flat plate taken in the upright and in the left lateral decubitis positions, since minimal free air may be missed on fluoroscopy and shown on the flat plate. Likewise, air may be missed in the upright position and be shown in the lateral position. This can easily be done by having the patient lie on the hospital cart en route to the operating room without the loss of important time. These films should be taken posterior-anterior, not anterior-posterior (Fig. 17, 18).

In the decade that followed the first demonstration of spontaneous pneumoperitoneum, many surgeons and clinicians deprecated the aid given by the x-ray in the diagnosis of acute perforations. Singer, in an article published as late as 1929, summarized many of the objections presented, e.g. "as unnecessary manipulations of the patient caused by the x-ray examination," or that valuable time was consumed in making the examination. Other surgeons and internists offered no objections to radiographic examination, but stated that they did not need it for diagnosis. To quote directly from Singer's article, is the statement of a colleague who felt that the "x-ray was not practical" and who requested

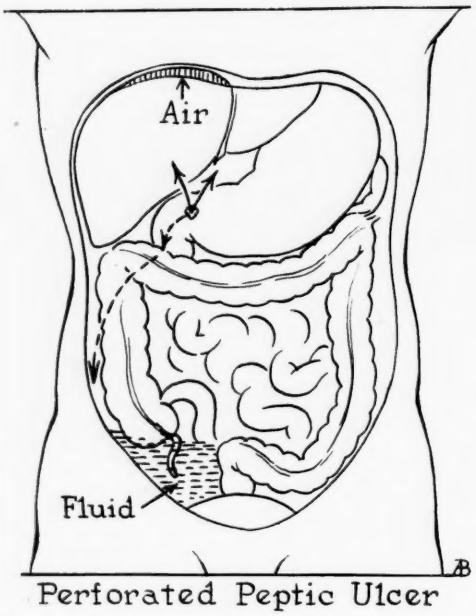



Fig. 11. Diagrammatic illustration of the manner of gravitation of fluid from the epigastrium to the right iliac fossa.

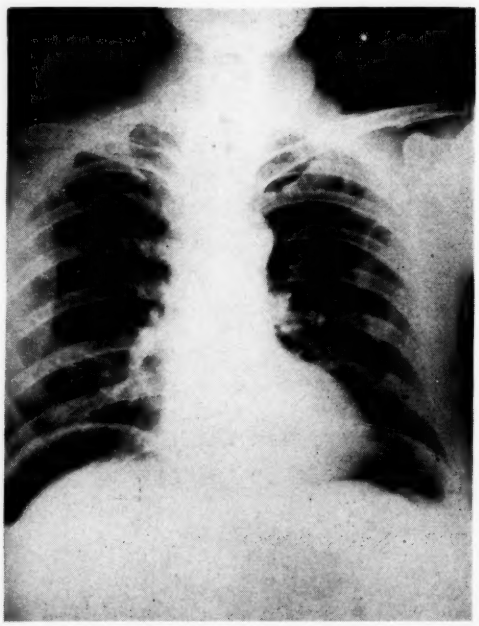


Fig. 12. Roentgenogram showing the presence of spontaneous pneumoperitoneum.

in a case of perforated ulcer an "hourly blood count to determine the presence or absence of a perforative peritonitis." The fluoroscopic examination readily settled the problem.

As surgeons we should make the earliest diagnosis possible by the use of every means at our disposal. Without a proper appreciation of the significance of the presence of spontaneous pneumoperitoneum we jeopardize the very existence of those who otherwise could have obtained early surgical aid.

SUMMARY

1. Spontaneous pneumoperitoneum occurs

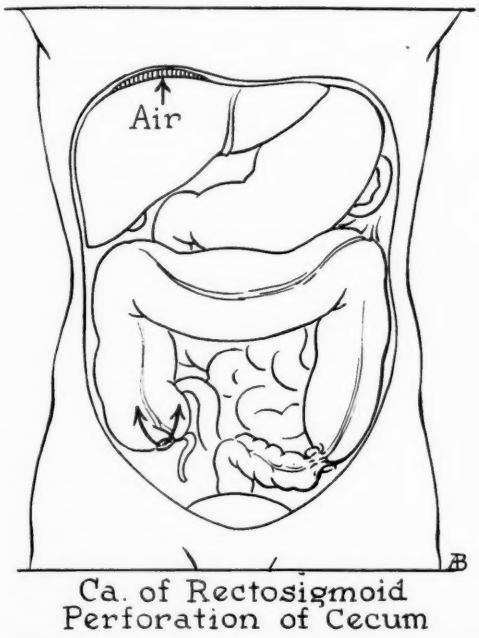



Fig. 13. Diagrammatic illustration of the pathology present in the patient described above.

with the perforation of a hollow viscus and when present is of diagnostic aid.

2. The incidence of its presence is greatest with perforative lesions of the colon and stomach.

3. Spontaneous pneumoperitoneum may be divided into the *immediate* form and the *delayed* form. The former presents itself within a matter of minutes or a few hours. The latter does not present itself for a period of days or weeks after the initial process has occurred.

4. The amount of air necessary for its presence may be as little as five cubic centimeters.

5. In the adult air is not normally present in the lumen of the small intestine. In infants and children up to the age of three, air frequently will be present within the lumen of the small intestine as a normal finding.

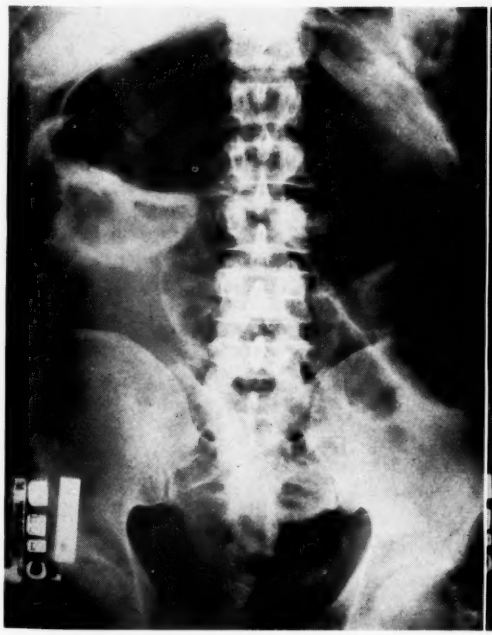


Fig. 14. Roentgenogram showing the pneumoperitoneum.

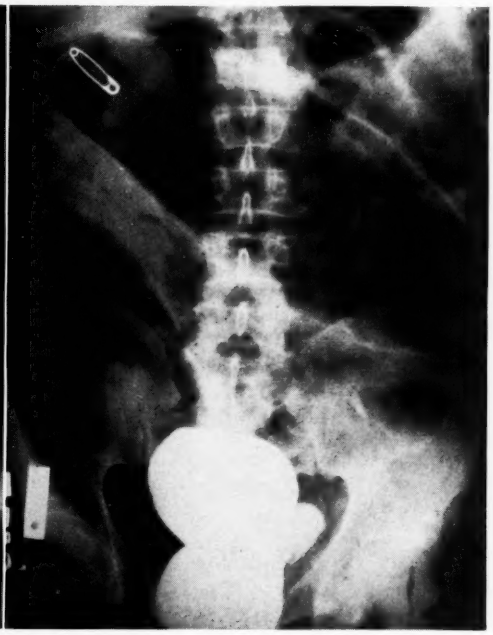
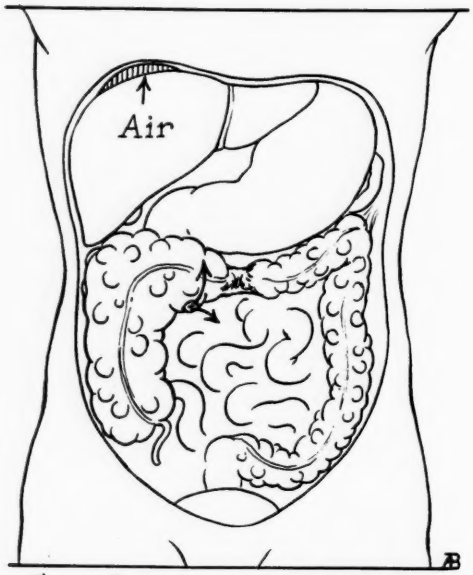


Fig. 15. Barium has been introduced to the point of obstruction.




Ca. of Transverse Colon
Associated Diverticulosis
Perforation of Sac

Fig. 16. Diagrammatic illustration of the pathology that was present in the second patient.

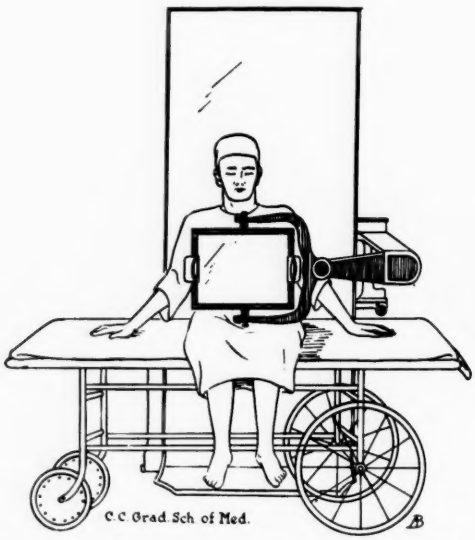



Fig. 17. Position of the patient for fluoroscopy and taking of film in the upright position.

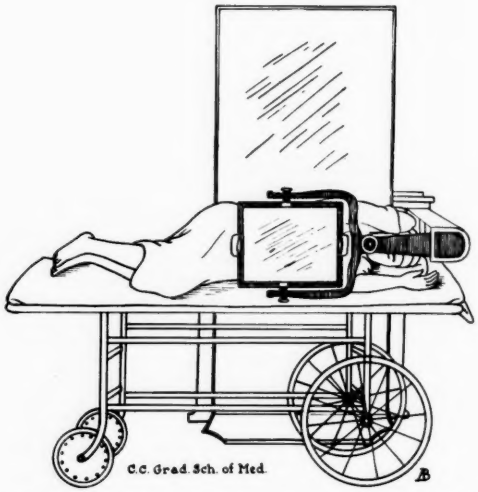



Fig. 18. Position of the patient in left lateral decubitus for fluoroscopy and taking of film.

6. In acute perforations of the stomach or duodenum, the positive finding of spontaneous pneumoperitoneum is present in 80 to 85 percent of the cases.

7. The technic for its demonstration is simple and not time consuming.

RIASSUNTO

1. Un pneumoperitoneo spontaneo segue la perforazione di un organo cavo e ne facilita la diagnosi.

2. Quest'evenienza e' piu' frequente nelle lesioni perforative del colon e dello stomaco.

3. Il pneumoperitoneo puo' essere immediato o ritardato. Il primo insorge nell'intervallo di minuti o di ore: il secondo di settimane.

4. Bastano 5 cc. di aria per dar luogo ad un pneumoperitoneo.

5. Negli adulti l'aria manca generalmente nel lume dell'intestino tenue. Nei bambini fino a 3 anni la sa presenza e' invece frequente e normale.

6. Il pneumoperitoneo insorge nell'80-85% dei casi di perforazione dello stomaco e del duodeno.

7. La tecnica per dimostrarne la presenza e' rapida e facile.

SUMARIO

1. El neumo-peritoneo espontaneo resulta de la perforacion de las visceras que comunican con el exterior; por lo tanto cuando se presenta es de valor diagnostico.

2. Su incidencia es mas comun en las perforaciones del estomago o de las del colon.

3. El neumo-peritoneo espontaneo se puede dividir en una forma inmediata y en forma tardia. La inmediata occurre en minutos o en pocas horas. La tardia generalmente se presenta despues de un periodo de semanas.

4. La cantidad de aire puede ser tan poca hasta no ser mas de 5 cc.

5. En el adulto el aire no se presenta normalmente en el intestino delgado. En cambio en la infancia hasta la edad de tres anos es una manifestacion normal del intestino delgado.

6. En el 80 a 85% de los casos de perforaciones agudas del estomago o del duodeno se presenta el neumo-peritoneo espontaneo.

7. La tecnica para demostrar esta complicacion es simple y requiere poc o tiempo.

SOMMAIRE

1. Le pneumo-péritone spontané survient après la perforation d'un viscère creux et facilite le diagnostique de la lésion causale.

2. L'incidence de cette condition est plus fréquente avec les lésions perforatives du colon et de l'estomac.

3. Le pnélopéritoine spontané peut être divisé en forme immédiate et en forme retardée. La forme immediate se manifeste au bout de quelques minutes ou de quelques heures. La forme retardée ne se presente qu'après une semaine ou plus après l'occurence de lesion causale initiale.

4. La quantité nécessaire pour révéler la présence d'air dans le péritoine, peut être aussi petite que 5cm3.

5. Chez l'adulte, l'air n'est pas normalement présent dans le lumière de l'intestin grêle. Chez l'enfant jusqu'à l'âge de trois ans, l'air fréquemment est présent dans la lumière de l'intestin grêle et est normal.

6. Dans les perforations aigües de l'estomac ou du duodénum, on recontre le pneumopéritoine spontané dans 80 a 85% des cas.

7. La technique pour la démonstration de cette complication est facile etre prend que peu de temps.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# Acute Vascular Thrombosis of Small Intestine

## Experience with Mesenteric Occlusion and Jejunal Infarction

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AS ONE reviews the literature on the surgical pathology of mesenteric and vascular thrombosis of the small intestine, it is surprising to see how few elaborate discussions are included. The textbook pictures and the most authoritative authors on intestinal surgery give the reader an impression of inevitable death due to shock and fulminating toxemia. In my experience this does not always hold true.

During the past year at the Bayamón District Hospital, Puerto Rico, we have encountered a surprising number of cases of infarction of the the small intestine due to circulatory disturbance of the mensenteric vessels. The gross pathologic picture was that of a segmental inflammatory lesion with thickening and edema of the mucosa and submucosa. The serosa was opaque and surrounded with lustrous purple bands. Microscopically the lesion showed edema and small areas of hemorrhage in the submucosa, with small infarcts at various levels of the jejunum. I have called this condition acute segmental enteritis, because there is pathologic confirmation of the surgical observations.

The cases presented in this paper were acute surgical emergencies based on severe abdominal pain without rigidity but with high leukocyte counts. Some patients have had the benefit of medical treatment before submitting themselves to operation. Of six patients treated during the past year, three survived large segmental resections and three died. For the three who died the preoperative as well as the postoperative course was characterized by typhoid-like temperature, thready pulse, persistent vomiting and generalized overwhelming toxemia. From the specimen the pathologist inferred that in two cases an overwhelming toxemia, such as bacterial endocarditis, had caused multiple emboli in the mesentery of the small intestine, producing a picture of multiple infarction. The third death occurred in an unusual case of Hodgkin's abdominal granuloma of the mesentery of the small intestine with multiple infarction of the jejunum. No axillary, inguinal or cervical adenopathic lesions could be demonstrated, and the blood picture was normal except for a high leukocyte count.

The three patients who survived resection were young; one was a child 12 years of age and two were adults. These patients are still under observation for what is described as chronic abdominal disease. This is a clinical condition described by Wilensky and characterized by ill-defined abdominal pain, anorexia, loss of weight, sprue-like symptoms of flatulence, avitaminosis, and undeveloped physique in proportion to age.

Patients who recover from mesenteric vascular thrombosis are potential victims of regional ileitis in later years. One must not forget that the whole surgical pathology of the intestine and the mesentery is predominantly a matter of reactive adenitis. The lymph glands undergo a structural variation of hyperplasia, sinusoidal dilatation and excessive reticulum formation. Enteritis is a pathologic dysfunction secondary to what Pribram calls lymphangitis mesenterialis.

It may seem strange also that clinically, in many cases of mesenteric vascular occlusion, a fairly mild course is observed for a long period before a serious lesion develops. As Wangensteen expresses it, "a patient, occasionally, will show a strangulating obstruction and a devitalized bowel, demanding excision but with no manifest evidence of any sign of distention." But, as can be seen from the film, the edematous manifestation of the segment of bowel does not compromise the blood flow of the bowel through mechanical blockage. In most cases the jejunum is involved. The lumen is patent, although swollen mucosal folds re-

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duce the caliber. The end-to-end anastomosis performed in all these cases "takes" successfully, without technical complications of loss of circulation, loss of viability of the apposed ends, or fistulization.

In the cases presented in this paper I am dealing with a particular problem encountered in the emergency service of a charity hospital. The patients are chronically undernourished, with untreated vitamin deficiencies of long standing.

## ETIOLOGIC CONSIDERATIONS

In most cases, mesenteric vascular thrombosis occurs in young or middle-aged persons. Prior to the onset they notice nothing more than mild dyspepsia. Jackson Porter and Quimby found an equal percentage of cases in which the course was prolonged as much as eight days, and an equal number of far shorter periods. In my experience, distention, vomiting or diarrhea need not be prominent. It is possible that climatic conditions and the common incidence of lymphatic diseases in Puerto Rico may account for this.

Occlusions of the mesentery or the intestinal walls may consist of multiple emboli or multiple thrombi. In cases of the acute condition there may be preponderance of either lesion with evidence of the other.

The etiologic factors producing thrombotic occlusion of the small intestine are: (1) postoperative trauma to the mesentery; (2) mechanical strangulations by volvulus, hernia, or kinks; (3) stenosis of the portal system; and (4) lymphoblastoma (Hodgkin's lymphogranuloma).

The etiologic factors involved in the formation of emboli seem to be acute processes: (1) acute bacterial endocarditis; (2) any disease that disseminates emboli through the circulation, such as (a) staphylococcus septicemia or (b) acute ulcerative enteritis; (3) atheromatosis of the aorta; and (4) premature arteriosclerosis.

## REPORT OF CASES

*Case 1:* C. C., a white woman aged 21, was admitted to the Medical Service with pain in the left upper abdominal quadrant. Her main symptoms were vomiting, high temperature, diarrhea and abdominal distention, which would totally disappear with Wangensteen suction. The leukocyte count was 15,000 per cubic millimeter of blood, but the differential count was normal except for 15 percent eosinophils.

Roentgen diagnosis of a flat plate of the abdomen gave positive clinical evidence of intestinal obstruction.

Exploratory laparotomy revealed an extensive edematous process of the jejunum. There was a mechanical obstruction (due to edema) from the ligament of Treitz onward to a distance of about 30 cm. There was extensive lymphoid hyperplasia. The degree of mucosal edema was such that the serosa of the intestine became blotted out by a violaceous circular area, and the walls were thick and leathery. The capillary surface of the intestinal serosa was profusely mapped out after formalin fixation, and the bluish color tended to persist. A resection of about 1 foot of intestine was made (Fig. 1).

Fig. 1. Gross specimen. Note congestion of the serosal veins, signifying mesenteric thrombosis. Preservation of the specimen in solution of formaldehyde showed both capillary and venous congestion, indicating vascular embolism of a segment of the intestine.

After operation the patient had similar and progressive symptoms—a highly sustained fever, toxemia, and signs of peripheral vascular collapse —but these were not necessarily postoperative complications.

*Pathologic Report:* The gross specimen was a segment of small intestine 23 cm. long. The serosal surface was intensely congested and covered with a thin layer of fibrin at its central portion for a distance of approximately 8 cm. The mucosa was intensely congested and hemorrhagic in the central portion of the segment, corresponding to the area covered on the outside with fibrinous matter. Some

pieces of vegetable matter were still adherent to the mucosal surface. The mucosa was intensely edematous proximal to the lesion, but its appearance distal to the lesion was normal (Fig. 2). The appendix measured 10 x 0.5 cm.

Fig. 2. Intense mucosal edema of the intestine (same specimen as in Figure 1). Note thickening of walls.

For microscopic study, jejunal sections were taken from the central portion of the segment. These showed two fairly large wedge-shaped areas of hemorrhagic necrosis involving the mucosa and submucosa, and one of these included a small abscess. These areas exhibited arterioles and venules with extensive necrosis of their walls and early thrombosis. The adventitial tissue of the affected vessels showed a compact exudate of neutrophils, which were also infiltrating the necrotic walls, simulating minute abscesses. The remainder of the intestinal coats were edematous, congested and diffusely permeated by neutrophils, eosinophils, lymphocytes and a few plasma cells. A process of repair was noted, particularly in the submucosa, manifested by marked proliferation of fibroblasts and neoformation of capillaries. The two specimens were essentially similar. A third specimen, taken from the proximal extremity of the segment, showed moderate edema of the mucosa and submucosa.

*Diagnosis:* The anatomic diagnosis was mechanical intestinal obstruction (jejunal) due to infarction.

*Case 2:* J. R. O., a white girl aged 18, was admitted to the hospital on Oct. 24, 1946. There was a history of fever and of abdominal distention, relieved at times by Wangensteen decompression. The patient was acutely ill, her condition resembling typhoid. Surgical examination revealed severe strangulation and intestinal edema. The patient died of fulminating toxemia on the third postoperative day. The clinical diagnosis was strangulation edema of the jejunum.

*Pathologic Report:* The gross specimen was a segment of small intestine measuring 86 cm. in length, with thickened walls somewhat rigid. The serosa had lost some of its normal luster and was spotted irregularly by reddish and violaceous areas usually localized circularly around the circumference of the bowel. There was a soft, reddish, round area in the walls of the intestine localized 30 cm. from one extremity of the bowel and closed to its mesenteric attachment. These areas measured approximately 2.5 cm. in diameter. On section the walls of the bowel at this point were soft, reddish-brown and necrotic; this area was covered by a yellowish fibrinopurulent exudate. Its lumen contained reddish sanguinous fluid. The mucosa was dark red and edematous; in some areas it was greenish with bile pigment. The dark red mucosa was about half of the entire thickness of the intestinal wall. The regional lumph nodes were hyperemic.

Microscopic sections were taken at different levels of the intestinal segment. They showed patchy areas of necrosis of the mucosa, which in places extended to the inner layer of the muscularis. A third section showed a large infarct involving all the coàts of the bowel. Many embolic thrombi were found in arterioles of the submucosa and mucosa. There was a pyogenic reaction underneath and about the areas of necrosis. The submucosa was edematous and closely infiltrated with lymphocytes, neutrophils, eosinophilic hystocytes, plasma cells and eosinophils; this cellular reaction was heavier about the blood vessels. A similar but milder exudate was present throughout the muscularis and serosa. The collagenous stroma in the submucosa manifested fibrinoid degeneration. Sections from both extremities showed histologic changes similar to those observed in the other two specimens.

The mesenteric lymph node showed a moderately large infarction with a thrombosed vessel toward its center.

*Diagnosis:* The anatomic diagnosis was multiple septic infarction of the small intestine (jejunum) due to thrombotic emboli of the mesentery and intrinsic vessels of the small intestine; septic embolic infarction of the mesenteric lymph nodes, and edema and acute enteritis secondary to the primary infarction. The origin of the emboli was undetermined.

*Case 3:* E. R., a 42-year-old mulatto, was admitted to the medical service with severe epigastric

Fig. 3A Fig. 3B Fig. 3C

Fig. 3A. Small polypoid tags in mucosa, with much edema. B. Greatly thickened edematous lumen with evidence of thrombosis in submucosa. C. External appearance of serosa.

pain associated with melena. There was no previous history of gastrointestinal complaints. Physical examination gave negative results except for a suspicious mass in the left upper quadrant of the abdomen, slightly tender on palpation and associated with bloody, bright red stools. The patient was dehydrated and had a very high temperature.

Clinical laboratory tests gave relatively normal results, which is highly significant. The leukocyte count was 10,750 per cubic millimeter of blood, with 72 percent polymorphonuclear cells, 24 percent lymphocytes, 0.3 percent eosinophils and 1 percent basophils. The result of the Kahn test was negative. Examination of the stools revealed no parasites. Urinalysis resulted in a value for albumin of 3 plus.

Exploratory laparotomy revealed a rare pathologic specimen, associated with vascular thrombosis and with acute Hodgkin's granuloma of the intestinal variety.

On review of the physical signs, there was no suspicion of previous axillary or inguinal adenopathy, not even blood dyscrasia. A Vidal test gave negative results. The patient died on the fourth postoperative day, with symptoms of impending uremia and fulminating toxemia unabated by antibiotics or supportive medication.

*Pathologic Report:* The specimen was a segment of the jejunum that occluded the duodenum. This patient had multiple jejunal infarctions and extraordinary mesenteric lymphadenopathy, and the mucosal folds were invaded by a typical polypoid tag (Fig. 3).

A piece of intestine measuring 57 cm. in length was removed from the duodenojejunal area. The intestine was thickened uniformly for the first 30 cm. The subsequent portion of the jejunum appeared ecchymotic in places. There was much edema of the lumen of the intestine, particularly in the proximal portion. The mesenteric lymph nodes were markedly enlarged.

Microscopically, the walls of the small intestine, particularly the mucosa, submucosa and circular layer of the muscularis, were occupied by a large hemorrhagic infarct. The mucosa had undergone complete anemic necrosis, the submucosa was infarcted with blood, and the circular coat of muscularis included extensive areas of more recent hemorrhage. Necrotic changes were also evident in these two layers and in the muscle fibers of the longitudinal layer of the muscularis. Embolic thrombi were found in the capillaries and small arterioles of the various coats of the intestine. The mesenteric lymph nodes exhibited the granulomatous changes of Hodgkin's disease.

*Diagnosis:* The anatomic diagnosis was Hodgkin's disease of the mesenteric lymph nodes; infarction of the small intestine due to mesenteric thrombosis, and enteritis of undetermined cause.

The following cases are of those patients with acute abdominal symptoms who were also examined on the basis of a clinical impression of regional enteritis. Note the comparative incidence in a year's time, and also the fact that, in spite of the interesting histopathologic description, systemic fulminating toxemia of multiple thrombosis did not develop in these patients.

*Case 4:* A young girl complained of acute abdominal pain associated with severe leukocytosis and vomiting. There was some history of melena before admission.

Resection of a mesenteric thrombus (Fig. 4) and a corresponding infarcted lumen of the intestine was performed. The operation consisted in resection of the diseased ileum and creation of an end-to-end anastomosis. Recovery was uneventful.

*Case 5:* S. R., a white man aged 27, was admitted to my service in the hospital on Jan. 15,

1946, with excruciating abdominal pain of several days' duration. He appeared to be in an acute phase of regional jejunitis with mesenteric adenopathy. Surgical exploration revealed regional jejunitis. Resection of 5 feet of the diseased intestine was performed, followed by an end-to-end anastomosis. The patient recovered uneventfully.

Fig. 4. Sections of intestine showing the lumen, with a thrombus on the mucosa (Case 4).

*Pathologic Report:* The gross specimen was a segment of small intestine, devoid of its mesenteric attachment and measuring 13 cm. in length. The serosal surface was slightly opaque and covered along the mesenteric attachment with a thin brownish fibrinous layer. The mucosa was moderately edematous, and the summits of the mucosal folds were grayish pink. There was slight to moderate thickening of the submucosa, muscularis, and serosa. Small pieces of greenish vegetable matter were found between the mucosal folds, mixed with mucus. Small areas of hemorrhage were seen in the mucosa and submucosa on section. A soft, swollen appendix measuring 10 x 1 to 1.5 cm. was observed. The serosa was opaque and the subserosal vessels congested. The lumen of the organ was dilated and filled with soft yellowish matter.

Microscopically, the jejunum showed large areas of hemorrhagic infarction at various levels, involving chiefly the mucosa and submucosa. The affected areas were partly bordered by an acute leukocytic reaction and large areas of hemorrhage. The mucosa was edematous, hyperemic, hemorrhagic and diffusely infiltrated with neutrophils, eosinophils, lymphocytes and a few plasma cells. The lymphatics and blood channels of the submucosa were dilated. The inflammatory reaction was more severe about the blood channels. The walls of some of the arterioles were infiltrated with neutrophilic leukocytes. Small thrombosed blood channels were seen in the submucosa at the base of the area of hemorrhagic necrosis. The muscularis, particularly

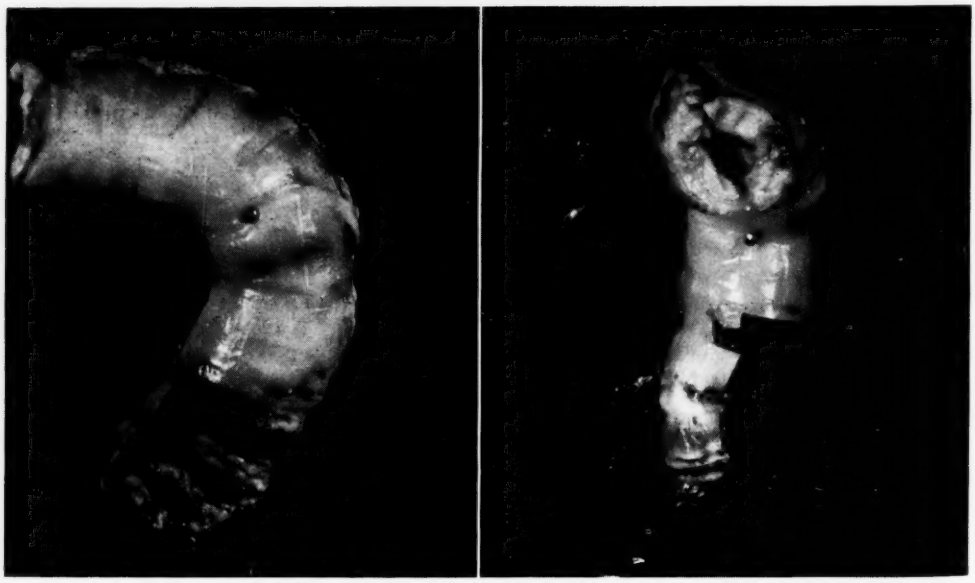

Fig. 5. Infarction of the jejunum (Case 5). Note the edematous submucosa of the bowel wall.

the external layer, showed early degenerative change. A section taken from one of the extremities or surgical cuts of the intestine showed mild to moderate inflammatory reaction of the mucosa, submucosa, muscularis and serous coat, and vascular dilatation of the submucosa. The appendix showed mild inflammatory reaction of the serous coat.

*Diagnosis:* The anatomic diagnosis was infarction of the jejunum due to circulatory disturbance (Fig. 5); enteritis of undetermined cause, probably secondary to infarction, and periappendicitis (reactive peritonitis).

Fig. 6. Jejunal infarction due to circulatory disturbance, associated with enteritis (of undetermined cause but probably secondary to infarction) and periappendicitis (reactive peritonitis).

*Case 6:* C. E. S., a white girl 12 years old, had acute intermittent gastric pain and some vomiting. Food increased the pain. The condition was tentatively diagnosed as intussusception. A segment of small intestine 90 cm. long, with much obstructive edema and multiple hemorrhagic jejunal infarcts, was resected. Recovery was uneventful. The submucosa of the bowel wall was thickly edematous (Fig. 6).

*Pathologic Report:* The gross specimen presented several small hemorrhagic infarcts, involving principally the mucosa and localized toward the center of the specimen. Otherwise its general appearance was normal.

Microscopically, four sections were studied. The first showed a moderately large wedge-shaped area of hemorrhagic infarction toward the center, involving the mucosa, the submucosa and a portion of the circular muscle coat. It was rimmed by an exudate composed of neutrophils and a few lymphocytes mingled with eosinophils. The surrounding tissues were congested and edematous. The other three specimens showed slight congestion of the veins and capillaries and some dilatation of the lymph vessels.

*Diagnosis:* The anatomic diagnosis was slight hemorrhagic infarction of the jejunum.

## SUMMARY

Experience with surgical pathologic conditions of the small intestine, especially regional enteritis and vascular thrombosis, is presented. Histopathologic as well as clinical differential diagnosis are discussed. It is emphasized that vascular thrombosis of the small intestine is not an inevitable cause of death in young persons.

A theory is advanced that the etiologic factor need not be any specific organism, but that the disease behaves similarly to schistosomiasis, tuberculosis, Hodgkin's granuloma, sarcoid, and bacterial infection, with a granulomatous reaction that injures the lymphatic circulation.

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# A Radical Treatment for Inguinal Hernia*

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INGUINAL hernia, without doubt, has been the most discussed subject in surgical annals. There is seldom a Surgical Congress without at least one paper dealing with some aspect of hernia repair. Whenever a group of physicians assembles for a general surgical discussion, someone will surely introduce his experience with herniorrhaphy. Most of what is said is not new. To illustrate, allow me to refer you to the instance of the presentation of papers by Martin[9] and Collins[3] before the Southern Surgical Association in 1941; followed by a discussion by such authorities as Charles R. Robins, William Reinhoff, Bradley S. Coley, Charles Green, Duval Jones, Amos Koontz and John E. Cannaday.

Perusal of what was said in that meeting demonstrates without danger of refutation that even among outstanding surgeons there is no unanimity of opinion as to what constitutes the proper operation to cure an inguinal hernia. Recurrence of a repaired hernia has been frequently blamed on the use of absorbable sutures, and yet silk, cotton and various plastic sutures are regularly found buried in some of the most troublesome recurrent hernias. The progress that has been made in surgery generally is the result of careful and detailed study of failures and successes alike, always hopeful that in the next case the experience already gained will make possible a more perfect result. With such a background, I do not feel immodest in describing a procedure which, in our hands, has proven extremely satisfactory, whether one is dealing with a simple hernia or one which is complicated by strangulation or recurrence of a previously repaired hernia.

It was estimated that for some years prior to the recent war, 10 percent of surgical treatments in hospitals in the United States were for cure of inguinal hernia. It has been further stated that approximately 10 percent of the male population of the United States has, or has had, an inguinal hernia. In terms of manpower for military purposes, therefore, inguinal hernia is a major problem, in that the man with a hernia does not make an acceptable soldier. The full significance of this statement could be witnessed by surgeons in military hospitals adjacent to Army reception centers during World War II, where inductees with observed hernia were immediately transferred for operation prior to active duty and where many more soldiers arrived with previously unnoted hernia, detected during the strenuous exercises of Army training.

For those who have undergone herniorrhaphy, as well as for those whose abdominal structures potentially lend themselves to the development of inguinal hernia, the physical requirements of soldiers are a real proving ground in determining whether there will be recurrence of a repaired hernia, or the development of hernia in the structurally weak abdominal wall. Even today, a large number of veterans admitted to Veterans Hospitals for elective surgery carry the admission diagnosis of "inguinal hernia." Recently, a number of recurrent inguinal hernias were carefully scrutinized to discover, if possible, why former operations had failed.

Among the cases of recurrent hernia examined, the Bassini[1] technic had been most often employed, although a lesser number had had the Halsted or Ferguson method of repair at their previous operations. The findings were varied, but resulting opinions are consistent with an editorial[4] in the United States Naval Medical Bulletin: "A hernial operation is a plastic operation of the highest order, demanding not merely an appreciation of simple esthetic approximation of tissue, but a thorough knowledge of the architectural mechanics involved. It is not surprising that failure should follow a procedure that is founded on unsound anatomic and physiologic principles."

Two factors seemed prominent in contributing to the recurrence of these inguinal hernias.

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It was noted that occasionally a hernia sac of small dimension had been overlooked or was incompletely obliterated. In certain instances, apparently a "pantaloon" sac had existed when at operation only the indirect or lateral sac had been treated and the medial sac was unobserved. The second and more prominent factor in the recurrence of the hernia was that at the first herniorrhapy a bridge had been constructed across a deficient portion of the lower abdominal wall at the inguinal canal, by transplanting a rudimentary or fragile conjoined tendon to cover the defect. This transplant was reinforced by the overlying rigid, unyielding aponeurosis of the external oblique muscle, which, under strain, had been forced to "give" but which did not have the elasticity to retain its integrity.

From the same editorial cited above, we quote: "Furthermore it has been pointed out that an intact falx inguinalis aponeurosis, or the so-called conjoined tendon is present in less than 20 percent of the individuals. Any operation therefore founded upon such an inconstant structure as the conjoined tendon is doomed from the start to failure, proportionate to the presence of that structure. Add to this the personal error of the surgeon's failure to recognize the structures before him and the lack of appreciation of the etiologic factor productive of a hernia, and the appalling high ratio of recurrence is easily understood."

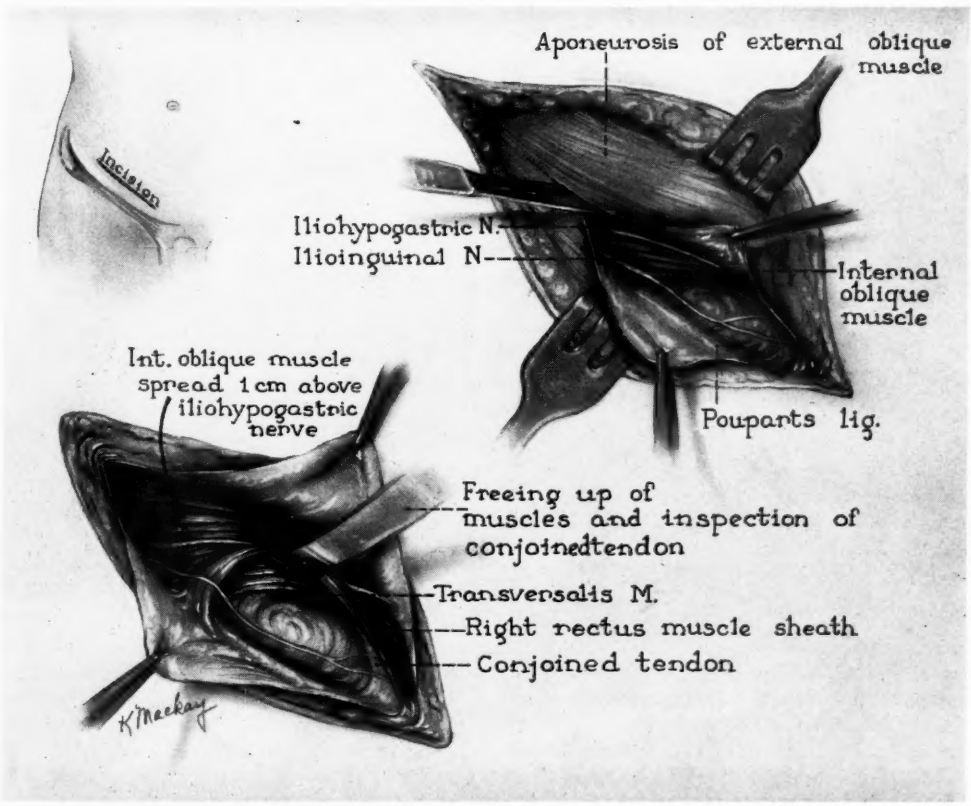


Fig. 1. Anatomic illustration to show the location of incision and steps of dissection approaching the peritoneum. (The drawing shows the muscle splitting above the iliohypogastric nerve. The extreme variability in the course of the iliohypogastric and ilioinguinal nerves usually requires that the muscle split occurs in interval between the two nerves.)

Certain surgeons have emphasized the importance of the transversalis fascia in hernia repair, and rightly so, but here again, any operation dependent for its success on such an irregularly potent structure as the transversalis fascia will experience inconstant results. It is necessary then to look upon herniorrhaphy as an extremely technical procedure, and one should not be considered capable of undertaking the operation until he is thoroughly conversant with the variations in the anatomy involved.

The foregoing discussion is the prelude to the presentation of a method of herniorrhaphy designed to overcome objections to other methods of operation and combine what seem to be the most valuable procedures available. In the experience of those who have mastered this technic, the entire operation seems to have been simplified. They now have difficulty in performing one of the "standard herniorrhaphy" operations to their satisfaction. We[8] have previously described the procedure of locating and disposing of the peritoneum-lined sac, which is an adaptation of an original technic described by La Roque.[6] Williams[10] has discussed this same approach to the hernia sac from within the abdomen and later fully de-

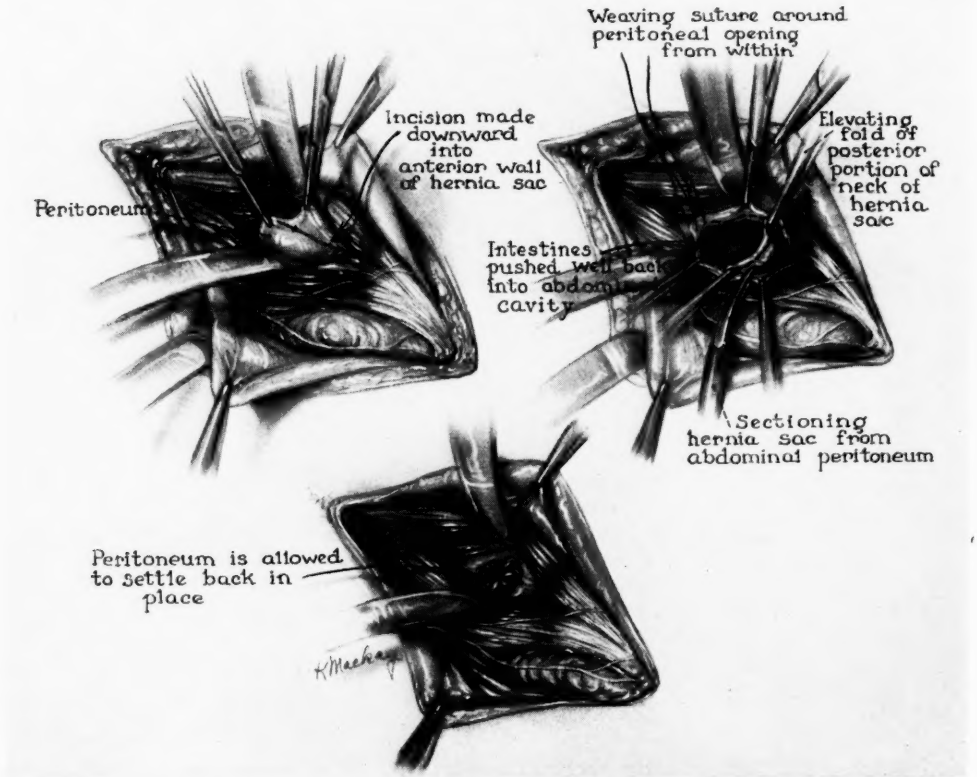
Weaving suture around peritoneal opening from within
Incision made downward into anterior wall of hernia sac
Elevating fold of posterior portion of neck of hernia sac
Peritoneum
Intestines pushed well back into abdominal cavity
Sectioning hernia sac from abdominal peritoneum
Peritoneum is allowed to settle back in place

Fig. 2. Anatomy illustration to show method of opening the peritoneum, exposure of the hernia sac and closure of the peritoneal cavity after excision of the hernia sac.

scribed its advantages, especially in dealing with the difficult sliding hernia of the cecum or sigmoid.[12]

## PROCEDURE

After making the usual skin incision, two fingerbreadths medial and parallel to Poupart's ligament, from a point opposite the anterior-superior iliac spine to a point over the pubic tubercle, Scarpa's fascia is opened and the underlying aponeurosis of the external oblique muscle is cleared medially to the lateral border of the rectus sheath and laterally to Poupart's ligament, so that the external inguinal ring is plainly visible below and the junction of the aponeurotic fibers and muscle bundles of the external oblique can be seen above. Then the aponeurosis of the external oblique is carefully incised upward from below, beginning just medial to the midpoint of the external inguinal ring and extending the entire length of the aponeurosis. The two leaves of the aponeurosis thus made by the incision are freed medially to the lateral edge of the rectus sheath and laterally to the fold forming Poupart's ligament. The lower border of the internal oblique muscle is outlined and gently freed from the spermatic funiculus. The conjoined tendon is also inspected, noting its extent and structure. (One seldom finds a conjoined tendon which resembles the structure as described in the anatomy text.[2]) Complete absence of the lower muscle fibers of the internal oblique, whose medial insertion principally forms the fibers of the conjoined tendon, is frequently noted.)

The branches of the iliohypogastric and ilio-inguinal nerves are observed but not disturbed. At a point about 1 cm. above the usual course of the ilio-inguinal nerve, the internal oblique muscle is spread in line of its muscle bundles and the peritoneum is approached as with the McBurney gridiron technic for appendectomy. The peritoneum is opened and the incision is extended downward into the anterior wall of the hernia sac, which can be seen easily in the indirect hernia and palpated in the direct hernia. In the instance of the indirect hernia sac, a hemostat is placed on the medial and lateral expansions of the "peritoneal ring," and while traction upward is made on these clamps, the sac is excised just distal to the "peritoneal ring." On the other hand, in the case of the direct hernia sac, the exploring finger, introduced into the peritoneal cavity, locates the bulging peritoneum and by lifting this peritoneum upward, the bladder and extra peritoneal tissues are wiped downward, obliterating the direct hernia sac. Under ordinary circumstances the vas deferens and spermatic vessels are observed as they ascend from the pelvis but are not disturbed unless they adhere to extraperitoneal adventitia of the sac. Then the peritoneal cavity is closed by weaving a suture around the opening in the peritoneum from within, being careful not to include any extra-peritoneal structures (with special reference to catching only the serosal covering of the bladder in the direct hernia sac.)

Under gentle traction, the peritoneum is closed as the "purse string" is drawn and tied. No effort is made to excise the peritoneal collar which projects beyond the suture. The peritoneum is allowed to settle back in place while the aperture in the overlying muscle layers is closed by two or three loosely tied sutures which include the transversalis fascia in the bite. If the indirect sac is long or extensive, it is incised longitudinally as far as the pubic tubercle and the two edges thus made are tacked under the cremaster muscle by a few interrupted sutures so that in subsequent steps, the serosa lining the sac will be in apposition to the under surface of the internal oblique muscle.

At this point it is necessary to plan the architecture of the future inguinal canal, based upon examination of the developmental status of the structures involved. Silk sutures are inserted through the lower edge of the internal oblique muscle and the shelving border of Poupart's ligament downward from above in a position of approximation without tension. The last approximating suture is inserted at the junction of the conjoined tendon and the internal oblique muscle fibres. These sutures are not tied, but caught in a clamp and laid aside to act as guides during the insertion of aponeurotic suture as follows: A strip of medial leaf of the aponeurosis of the external oblique about 0.5 cm. in width is freed downward from above and left firmly attached about the pubic tubercle. This strip of aponeu-

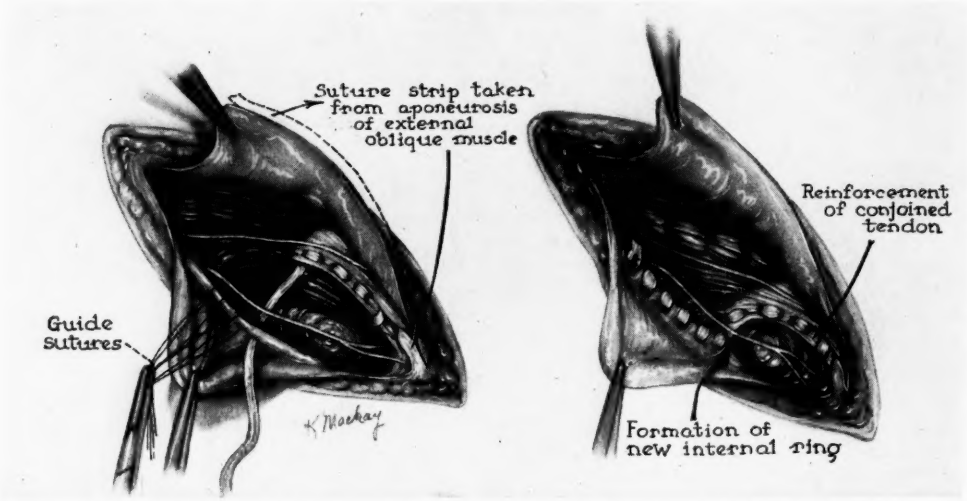
Suture strip taken from aponeurosis of external oblique muscle
Guide sutures
Reinforcement of conjoined tendon
Formation of new internal ring

Fig. 3. Anatomy illustration to show method of approximation of the internal oblique and transverse abdominal muscles to Poupart's ligament by insertion of silk guide sutures before reconstruction of the internal inguinal ring; also, method of applying a strip of aponeurosis as a suture in reforming the internal inguinal ring and reinforcing the conjoined tendon.

rosis is threaded into a fascia needle and the remodeling of the inguinal region begun.

Beginning at the public tubercle, the first bite of the needle dips deeply so as to catch a firm hold in the transversalis fascia and, in completing the stitch rolls the fascia under whatever remnant of the conjoined tendon is found.

This procedure of plicating the transversalis fascia with the aponeurotic strip continues, either reinforcing the conjoined tendon or creating one until the lowest approximating silk suture is approached at the junction of the internal oblique muscle fibers and the conjoined tendon. Here the fascia needle is passed through the shelving border of Poupart's ligament at the point designated by the lowest approximating silk suture. One can now observe that a new internal ring has been formed, composed of the tucked-up transversalis fascia, the remnant of the conjoined tendon and the strip of aponeurosis, which arches over the spermatic funiculus without tension and yet obliterates the "weak space," without constricting the spermatic cord and its vessels. From here, the strip of aponeurosis is continued as an over, and, over suture, making alternate bites in the combined internal oblique and transversalis muscles and the shelving border of Poupart's ligament, approximating muscle to ligament firmly without tension. This strip of aponeurosis is finally anchored to Poupart's ligament with a fine silk mattress suture. The silk guide sutures may either be tied or removed, the latter being preferable in most instances. (By comparison one now observes an inguinal canal that resembles that described in the anatomy text.[2])

The remainder of the operation consists of a simple approximation of the cut edges of the aponeurosis of the external oblique muscle downward from above, finally constructing the new external inguinal ring loosely about the spermatic funiculus, imbricating only the lowest fibers Scarpa's fascia is closed by approximation of the cut surfaces, as is also the skin with fine silk sutures.

In conclusion, a brief statement is submitted of the advantages derived from the use of the herniorrhaphy method just described. A wide dissection of the inguinal region permits a survey of the anatomic structures involved and an

estimate of the plastic procedure required for a firm abdominal wall at its completion. By entering the peritoneal cavity through direct approach, the hernia sac is located with ease, especially with reference to the small sac, the direct sac or the combination "pantaloon" sac. In each instance the hernia sac can be obliterated more completely, without endangering adjacent structures, from within the peritoneal cavity than by any other method. (It is apparent that the peritoneal cavity is shortened in the inguinal region.)

In the case of strangulated or incarcerated hernia, the viscus or omentum concerned is completely under control before being released from the hernia sac and can be readily delivered on the abdomen with a minimal soiling of the peritoneal cavity for inspection or resection, as may be required. For the safe approach to and treatment of the sliding hernia,[12] the advantage is obvious. This approach is also exceedingly helpful in treatment of femoral hernia,[7] in that the femoral hernia sac can be located, inverted and closed with striking ease. (A single mattress suture can be inserted from above to narrow the femoral ring.)

Trauma to branches of the ilio-inguinal nerve is avoided in that it need not be disturbed. The spermatic funiculus is not traumatized nor disturbed, and testicular atrophy has not been observed, nor has postoperative swelling of the scrotal contents complicated surgery. The conjoined tendon is either reinforced or constructed by the use of the aponeurotic suture, while at the same time the transversalis fascia is tightened in the floor of the inguinal canal. The final result is an inguinal region which has the anatomic pattern found in the normal abdominal wall.

To date, only two of more than two hundred eighty hernias so repaired have come to my attention as recurrences. Both of these were in patients who had bilateral inguinal herniorrhaphy. Following occasions of extreme stress, these patients developed a bulge in the inguinal region. Both patients were reoperated upon to study the cause of apparent failure, and it was found that the original operative areas were intact, but that now there existed a direct hernia bulge at the lateral edge of the rectus sheath. Under such conditions, they could not rightly be termed recurrences, but rather hernias at a new site of weakness of the abdominal wall.

SUMMARY

It has been estimated that approximately 10 percent of the male population of the United States has or has had an inguinal hernia. Surgeons have never entirely agreed upon a method for surgical cure of inguinal hernia because no single technic takes into consideration the extreme variability in the anatomic structure of the inguinal region of the abdominal wall. A surgical procedure which is designed to employ an inconstant structure, such as the conjoined tendon or the transversalis fascia, as an essential item in its performance will be successful only in proportion to the integrity of that structure. It is necessary that the operator be not only a technician but an experienced student of anatomy and physiology in order to recognize the etiologic factors responsible for the production of each herniation.

A step-by-step description is given of a procedure which requires a wide dissection of the inguinal region and an approach to the hernia sac from within the peritoneal cavity. After the hernia sac has been disposed of and the peritoneal cavity closed from within by this method, a strip of the aponeurosis of the external oblique attached at the pubic tubercle is employed as a living suture to construct or reinforce a conjoined tendon and produce an internal inguinal ring which closely resembles in structure and function that which is usually described in the anatomy text. Although this method of herniorrhaphy may be considered a radical surgical treatment, it is actually a plastic operation for the cure of an anatomic abnormality.

RIASSUNTO

Le statistiche dimostrano che il 10 percento circa, della popolazione maschile degli S.U. è stata od è affetta da un'ernia inguinale. Nonostante una percentuale così elevata, manca ancora un metodo sul quale i chirurghi siano tutti d 'accordo, in quanto nessun metodo puo' essere applicato a tutte le possibili variazioni anatomiche del canale inguinale. I metodi finora adottati ricorrono infatti alla falce in-

guinale od alla fascia trasversale: strutture molto variabili nella loro integrità, donde risultati operativi molto incostanti. Il chirurgo deve essere non solo un tecnico, ma un cultore dell'anatomia e della fisiologia per riconoscere i fattori responsabili di una determinata ernia.

L'A. descrive un metodo operativo che richiede un'ampia dissezione della regione inguinale e che raggiunge il sacco erniario dall'interno della cavità peritoneale. Dopo che il sacco è stato reciso e la cavità peritoneale richiusa dall'interno, una striscia dell'aponeurosi del muscolo obliquo esterno, attaccata al tubercolo pubico, viene utilizzata quale materiale di sutura onde rinforzare la falce inguinale e ricostruire un anello inguinale interno simile—per la sua struttura e per la sua funzione—a quello comunemente descritto nei testi di anatomia.

Questo metodo di erniorrafia costituisce in realtà non tanto un'operazione radicale, quanto un'operazione plastica per la cusa di un'anomalia anatomica.

SUMARIO

Se ha estimado que aproximadamente un 10% de la poblacion masculina de los Estados Unidos sufren o han sufrido de la hernia inguinal. Los cirujanos aun no estan de completo acuerdo sobre el metodo de seleccion en el tratamiento de esta anomalia, por cuanto ninguna de las tecnicas que se han descrito reconocen la variabilidad anatomica de la region inguinal o de la pared abdominal. Un procedimiento quirurjico que depende para su exito el empleo de una estructura inconstante como es el tendon de conjunto, los resultados obtenidos dependeran indudablemente de la integridad de dicha estructura. Es necesario que el cirujano no solomente sea un tecnico adepto, sino tambien un buen estudiante de la anatomia y de la fisiologia de la region inguinal, pues solo asi podra reconocer los factores etiologicos responsables en la produccion de la hernia presente en cada caso.

Se ha descrito en detalle un procedimiento que requiere la diseccion amplia de la region inguinal y la reseccion del saco de hernia por la via intraperitoneal. Despues de la reseccion del saco y la sutura del peritoneo por la via intraperitoneal, se obtiene una banda de la aponeurosis del obliquo menor de insercion en el tuberculo del pubis y se emplea, como sutura viva, para reconstruir y reinforzar el tendon de conjunto y al mismo tiepo producir un nuevo anillo inguinal interno cuya estructura y funcion simile anatomicamente el anillo clasico de los anatomos.

Este procedimiento aunque se considere como un procedimiento radical es en realidad una operacion plastica en la correccion de una anomalia anatomica.

SOMMAIRE

Il est d'opinion générale que ten percent de la population male des Etats-Unis a ou a eu une hernie inguinale. Les chirurgiens n'ont jamais été entièrement d'accord sur la méthode à employer pour la guérison chirurgicale de la'hernie inguinale, parce qu'aucune technique ne prend en considération les differences anatomiques de la région inguinale de la paroi abdominale. Un procédé chirurgical basée sur l'emploi d'un élement anaîomique de structure inconstante tel que le tendon conjoint ou le fascia transversalis comme moyen, obtiendra une guérison en rapport avec l'intégrité de ces structures. Il est nécessaire que le chirurgien soit non seulement un bon technicien, mais soit aussi bien documenté sur l'anatomie et la physiologie de la région. Il doit reconnaitre les facteurs essentiels responsables de la prodiction d'une hernie. L'auteur donne une description détailleé d'un procédé qui demande une dissection étendue de la région inguinale et de l'approche du sac herniaire par la cavité péritonéale. Après la suppression du sac herniaire, un lambeau de l'aponévrose du muscle est ràttaché à l'épine pubiynne. On emploie une suture vivante pour construire ou renforcer le tendon conjoint et produire un anneau inguinal interne qui ressemble comme forme et fonctiona celui, décrit ordinairement dans les onvrages d'anatomie. Quoique cette méthodes herniorrhaphie peut être considérée comme le traitement chirurgical radical, c'est en verité une opération plastique pour la guérison d'une anormalité anatomique.

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# Open Operative Treatment of Major Fractures and Joint Injuries*

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THE two prevailing opinions concerning the treatment of major joint and bone injuries deal with the primary closed therapeutic method and the open surgical method. In both schools the objectives in the care of fractures and dislocations are rapid maximal functional and anatomic restoration with minimal morbidity and mortality.

Today the preservation of the tone and function of soft tissues, and the mobility of articulations, are of paramount importance. Older methods of prolonged immobilization produced an unsatisfactory end result which was largely attributable to muscle atrophy, ligament and tendon contractures, osteoporosis, degenerative ankylosing arthritis, and other sequelae resulting from long disuse.

Previously, surgery in fractures and dislocations has been used, particularly in large clinical centers.[9, 10, 14, 15 18, 30, 31] The work in this field, executed by such surgeons as Lambotte,[23] Lane,[24] and Sherman,[36] demonstrated the effectiveness of open operation in difficult cases. But catastrophic end results dissuaded most practitioners from undertaking open reduction save in exceptional instances. Since operative reduction implied the risk of converting an uninfected fracture into a case of major sepsis, the disadvantages of open reduction far outweighed its advantages.

In the past decade, however, with a therapeutic aramamentarium augmented by antibiotics, sulfonamides, transfusions, fluid-electrolyte, and protein replacement therapy all surgical horizons have expanded. Evaluations of open versus closed treatment of fractures based on the experience of 10 or more years ago, and omitting the newer adjuvants of operative care, can no longer be considered valid. The purpose of this paper is to survey the results of a relatively large series of operative cases observed from 1942 through 1947. These cases (all on the services of the senior author) were treated at a municipal hospital with average orthopedic operative facilities. The operators were some six members of the visiting staff in traumatic surgery or a succession of residents working under the direct supervision of the visiting staff.

We do not advocate the routine operative treatment of major fractures. However, with a decreased risk of infection now achievable, as demonstrated in this series, what was once the foremost objection to open reduction becomes much less significant and as a consequence elective indications have been amplified. Many authors have reported similar conclusions since 1940.

Notable among the articles advocating operative procedures in the treatment of these injuries are the studies of Burns and Young[4] Headings,[18] Mansfield,[25,] Murray,[29] Ronald,[34] Lee,[22] Stinchfield,[40] Collow and Erving,[7] Murphy,[29] and Bick.[6] These papers stress primary operative fixation in simple fractures, although compound fractures also are discussed. The recent monograph of Venable and Stuck[46] on primary internal fixation may become a classic thesis for this form of treatment.

## ADVANTAGES VERSUS DISADVANTAGES OF OPEN REDUCTION

The observation of Watson-Jones[48] (concerning the few methods of treatment, one condemning and the other advocating the general operative treatment of fractures) lies in the "job well done" by either method, is an apt aphorism indeed. The efficacy of both closed and open treatment depends on the choice of method and on the care given in the preliminary, definitive, and follow-up stages. Moreover, inadequate immobilization or treatment of shock in the initial period outweighs the most exact reduction, and inadequate re-

*An analysis of 257 cases treated at a municipal hospital from 1942 through 1947.

This paper was received for publication April 18, 1949.

habilitative physiotherapy is as disastrous as an unwise operation in determining the end results.

Early ambulation and its physiological benefits are now well established as a major advantage of internal fixation. In Lee's[22] series of 42 fractures of long bones treated by open reduction and screw fixation, the average patient was out of bed in a few days and was discharged in two weeks. The reported experience of many authors, as well as our own, illustrates that patients, particularly those with lower extremity fractures, may be safely discharged from the hospital within ten days to three weeks. Early ambulation is not synonymous with early weight bearing, but it does mean that the patient is not anchored to his bed by a cumbersome traction apparatus or a massive plaster cast, encasing half the body and completely immobilizing him from eight to 12 weeks. The optimum period for weight bearing or full use of an extremity varies with the type of fracture and we suggest a graduated, unhurried program of encouraging the resumption of limb function.

In complicated fractures, x-rays frequently do not reveal the degree of comminution. In many instances the more accurate visualization of the lesion at operation facilitates proper handling. Often the so-called conservative methods of treating fractures entail a risk tantamount to that of open reduction. Balanced traction methods require vigorous supervision, which is often unavailable. Consequently, distraction of the fractured surface may occur, a circumstance that militates strongly against the eventual production of dependable callus, even when separation is minimal. Pin traction methods, double or single, may be followed by infections varying from minimal to severe.

Siris[41] has stressed the dangers of pin traction, equating them with those of internal fixation as regards the incidence of serious infection. The occurrence of osteomyelitis in his series closely parallels that of other writers[11, 21, 36] in cases of open reduction. Kirby and Fitts,[20] in evaluating 342 cases during their war experience, using transfixion pins and wires, showed that pins for skeletal traction are relatively safe and reliable. In this later series, prophylactic oral sulfonamides were utilized in 60 percent. They reported only one serious infection and discounted the usual slight drainage from pin holes. This coincides with our experiences with internal fixation,

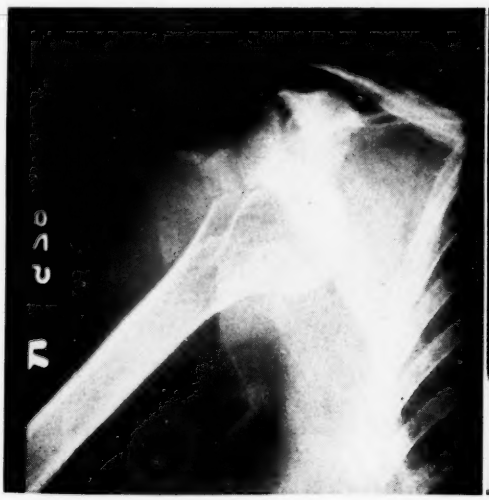


Fig. 1A. Dislocation of a shoulder with fracture of greater tuberosity. Attempted reduction by manipulation under anesthesia and by hanging cast.

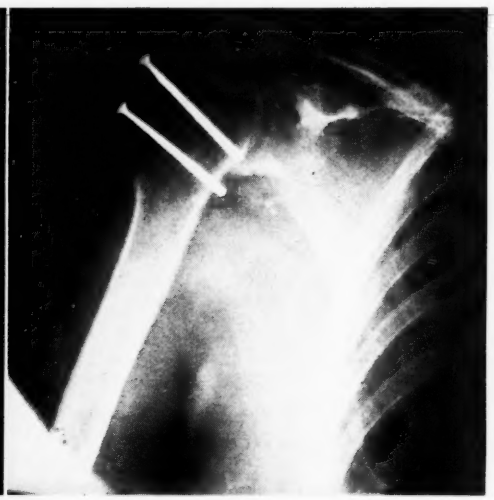


Fig. 1B. Roentgenogram six months later showing accurate reduction and restoration of normal contour of head of humerus. Note absence of exuberant callus.

in which patients treated in the era of sulfonamides and antibiotics ran a minimal risk of infection.

Buchmann and Blair[3] in 1947, reporting on the precautionary administration of penicillin in 41 surgical procedures on bones and joints, also have stressed the dependability of penicillin, showing that despite contamination, considerable trauma, or prolonged procedures, only one instance of infection occurred. This substantiates our experiences and those of other authors,[11, 19, 21, 22] and contradicts the older dictum that in open bone surgery infection transcends the dangers of distraction, delayed union, and nonunion. But anti-infective therapy is useless without proper surgical intervention.

Primary disadvantages of internal fixation are the usual operative risks of surgical morbidity and mortality. An unsuccessful operative procedure here (as in general surgery) or a local infection may increase the disability beyond the initial injury. A weak patient not adequately prepared for anesthesia or not prophylactically treated for shock is subject to serious complications. It is our experience that the incidence of such untoward aftereffects is not significantly increased in properly managed cases. A possible cosmetic disadvantage of open reduction is that the incisional scars may be unsightly. Wherever this is important, it merits consideration as a possible contraindication to surgical treatment.

## INDICATIONS FOR OPEN REDUCTION

Internal fixation is not the routine treatment of all fractures of the long bones. As successful operative procedures increase, the elective indications for surgical intervention will be enlarged. Today there is a marked variation from hospital to hospital in the extent to which surgeons resort to open reduction. Stinchfield[40] in 1947 estimated that in most hospitals less than three percent of fractures were so treated, and that at the Presbyterian hospital, New York City, open reduction was carried out in ten percent of all cases of fracture. The Fracture Report for 1946 from the Mayo Clinic[27] shows that, in this institution, 304 of 703 patients with fresh fractures were admitted to the hospital. Of the 304 hospitalized, 136 underwent open reductions, an operative management of approximately 45 percent. At the Cumberland hospital, of all patients hospitalized because of major fractures, 16 percent underwent open reductions from 1942 to 1947.

### THE INDICATIONS FOR OPEN REDUCTION.

I. *General—Advisable or Obligatory:* 1. Failure or instability of manipulative or distractive reduction, malposition, nonunion, malunion. 2. Probability of delayed union. 3. Associated tendon, nerve, or major vessel injury. 4. Massive soft tissue avulsion and destruction. 5. Major bone defects, soft tissue interposition. 6. Major joint disorganization. 7. Failure of initial operative reduction. 8. Multiple fractures posing unduly difficult mechanical problems in fixation.

II. *Specific—Desirable or Elective:* 1. Femoral shaft, oblique or transverse. 2. Neck of femur. 3. Tibia with fibula, middle and lower thirds. 4. Radius with ulna, with marked displacement. 5. Olecranon, with marked displacement. 6. Patella, with marked displace-

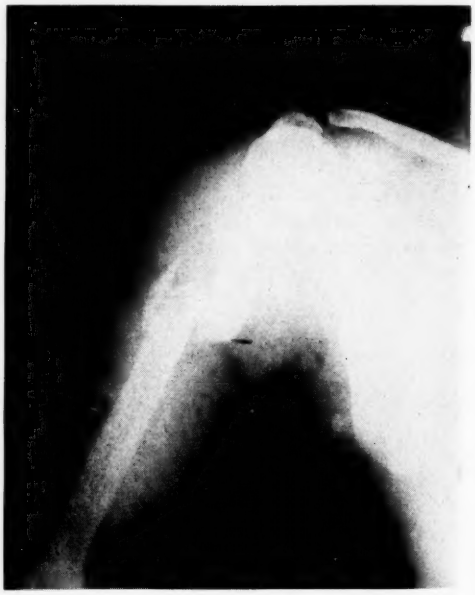


Fig. 2A. Comminuted fracture of upper humeral shaft with adduction displacement of proximal fragment. Reduction unstable after manipulation, traction, and plaster fixation.

Fig. 2B. Appearance after three weeks of treatment by hanging cast. Displacement marked with no evidence of union.

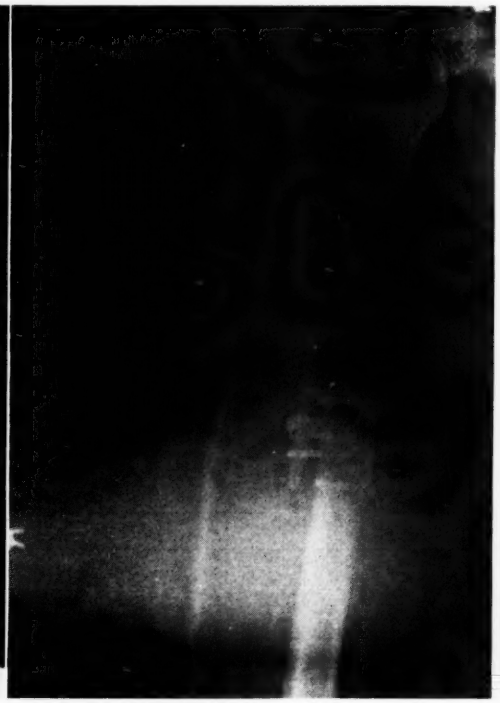


Fig. 2C. Bone graft and internal fixation after two weeks. Result after four months of operation.

ment. 7. Humerus, oblique or transverse, with marked displacement. 8. Head of radius.

Special indications for operative reduction may be presented by certain fractures that might also respond to the closed reduction method. Elective operation is suggested when early ambulation and discharge from the hospital is important to the patient, or when fractures of long bones, treated by manipulative procedures, require markedly uncomfortable retentive apparatuses in debilitated or obese patients. Occasionally patients have preferred operative treatment based on their experiences or on observations of other patients.

### SITE INCIDENCE AND METHODS USED IN THE PRESENT SERIES

This report covers 257 major bone and joint injuries and is a consecutive unselected series of patients operated on from 1942 through 1947. Table 1 summarizes the case distribution.

A variety of operative methods were utilized. Predominantly bone plating or screw transfixion were performed except in reductions of the fractured hip where hip nailing was done. The utilized procedures are the following:

*Methods Used* (alone or combined): 1. screw transfixion or bolt—25 cases; 2. nail transfixion—Moore, Steinmann—6 cases, Smith, Peterson—36 cases, Jewett, Knowl's etc.—12 cases; 3. internal wire fixation—heavy gauge or Kirshner—15 cases; 4. bone plating—47 cases; 5. parham bands—29 cases; 6. bone graft, tibial, ilial—12 cases; 7. intramedullary pegs—bone, metal—4 cases; 8. reduction, suture, external fixation and impaction (this group primarily in early years of series—32

cases; 9. kangaroo or grafted tendon suture—5 cases.

Table 1. *Site Distribution of 257 Major Bone & Joint Injuries**

| | | | Totals |
|---|---|---|---|
| *Fractures:* | | | |
| Humerus | Upper | 8 | |
| | Middle | 7 | |
| | Lower | 12 | 27 |
| Radius and ulna | Middle | 10 | |
| | Lower | 6 | |
| Olecranon | | 10 | |
| Ulna, shaft | | 2 | |
| Radius | | 10 | |
| Monteggia | | 2 | 40 |
| Femur, Neck | | 58 | |
| Shaft | | 26 | 84 |
| Patella | | | 8 |
| Tibia and Fibula | Upper | 5 | |
| | Middle | 15 | |
| | Lower | 13 | |
| Tibia | | 42 | |
| Fibula | | 1 | 76 |
| | | Total | 235 |

*Joint Injuries* (*Without Fracture*)

| | |
|---|---|
| Shoulder (dislocation) | 5 |
| Elbow (disolocation) | 2 |
| Wrist (dislocation) | 2 |
| Knee (Derangement of menisci) | 8 |
| (Osteochondritis desiccans) | 5 |
| Total | 22 |

*Excluding fractures of hip and olecranon, joint involvement was present in 33 patients, compounding in 53, and comminution in 61.

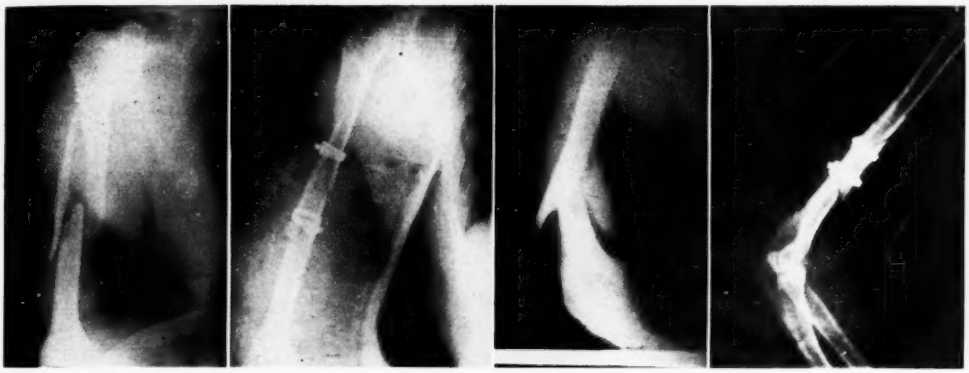
SURGICAL FUNDAMENTALS IN OPEN REDUCTIONS

*Emergency and Preparatory:* Pending operation fractures are mobilized or a corrective distraction apparatus is applied. Hemorrhage and shock are combated and anti-infective premedication is given. Infection prophylaxis may require the administration of serums, chemotherapy, or antibiotics. Specific preparations are directed against tetanus, gas gangrene, pyogenic organisms and the coliproteus bacteria. Systemic preoperative preparation may require restoration of fluid-electrolyte balance or replenishment of vitamin and protein reserves,[13] particularly in debilitated malnourished elderly persons. Local preoperative preparation must be done thoroughly, but we no longer prescribe the 48-hour extremity preparation used several years ago.

*Definitive:* The operation is performed under rigid aseptic technic. Meticulous debridement of all devitalized tissue is mandatory. Infected bone and foreign bodies require excision. A skin incision sufficiently adequate for good exposure is made, as a rule directly over the fractured area. Thorough familiarity with the anatomic location of important nerves and blood vessels is essential to safeguard these important structures. Muscles are sharply incised and separated with a minimum of trauma. Usually the periosteum is split and stripped, and bone reconstruction is carried out subperiosteally wherever possible, with maximum preservation of periosteum and soft tissue attachments. Careful exploration of the injury by direct inspection must be emphasized. The fracture is reduced as accurately as possible, and the fragments are held in position, as a rule, by means of suitable bone clamps until fixated. Copious saline irrigation is mandatory for compound lesions.

Mechanical problems are considered from the viewpoint of corrective orthopedic engineering, and the optimum means of adequate internal fixation (supplemented by external fixation where necessary) is decided upon. Plates and grafts must be of sufficient length to ensure rigid immobilization of the fracture fragments.[6, 22, 37, 36, 38, 46, 48] When simple screw transfixion is utilized, the direction of the screws in general should be at right angles to the fracture line rather than merely obliquely placed or inserted at right angles to the bone shaft. Screws must be long enough to penetrate both medial and lateral or anterior and posterior cortices.

The types of electrolytically inert rigid metal alloys best suited for internal fixation and the routine technical details are beyond the scope of this paper, but are considered in current literature.[33, 42, 46, 48] In comminuted fractures all fragments are preserved.



A B C D

Fig. 3. A, B, C, and D. Examples of comminuted fractures of humerus treated by internal fixation with Parham bands. Note the relative absence of external callus and translucent fracture lines five weeks after operation in both cases. This is a usual finding in internal fixation as described by Bick. Anatomical and functional end results, in both cases, were good.

for any loss of continuity of bone substance creates dead space or greatly weakens a healing fracture line. The test for adequate fixation is rigid immobilization. For injuries in which joints have been compounded, a complete and careful capsular closure is done. In closure, all layers are carefully sutured with a minimum of tension, and catgut, plain or chromic, is most frequently utilized for all buried sutures.

Although some authors[39] advocate the frequent open dressing of compounded fractures, we usually close such injuries snugly. Bone and muscle are never left bare and, where needed, temporary split thickness or permanent full thickness pedicled or free skin grafts are utilized for coverage. In a few instances of extensive tissue loss by avulsion or massive contamination, we have resorted to occlusive packing of denuded soft tissues, as a temporary measure.

Anatomic precision and careful operation are required for success and careful anesthesia; adequate operative facilities and trained assistants are indispensable. In our early cases, the various sulfa drug crystals were dusted into the wound. More recently we have used penicillin solutions, diluted for irrigation and concentrated for injection, before closure. Our primary dependence is upon the systemic administration of sulfonamides and antibiotics (in relatively large doses), for one to three weeks. Our postoperative retentive dressings vary. We agree with those authors that adequately transfixed fractures should require minimal external support and often none. At most a thinly padded light circular cast may be applied, or a Thomas splint.[11, 36, 40, 46] Although their significance must not be underestimated, further details of postoperative supportive care and physiotherapeutic regimes are omitted for reasons of brevity. As a rule, relatively early weight bearing is encouraged, but our program in this regard represents a compromise between past conservatism and the radically early ambulation now practiced in some clinics.

### ANALYSIS OF COMPLICATIONS AND FAILURES

Statistical comparisons of end results of the open reduction of fractures are somewhat difficult to assess, for individual case series are not strictly comparable. Moreover, the majority of articles published prior to 1945 dealt with a relatively small number of cases stressing open reductions for complicated, compound, or delayed-union fractures. Since a fairly large series of simple fresh fractures has rarely been presented, we will try to analyze and evaluate our own end results. A general concept of the recent incidence of failures and complications in open reductions

Table 2. *Deaths: Tabular Analysis*

| | Total cases | All deaths | Gross mortality rate, % | Corrected operative mortality, % |
|---|---|---|---|---|
| *Fracture Site* | | | | |
| Upper extremities | 76 | 0 | 0 | 0 |
| Lower extremities | 181 | 19 (total) | 9 | 6.6 |
| Femur, neck | 58 | 11 | 19.1 | 11 |
| Femur, shaft | 26 | 4 | 15.4 | 11.5 |
| Tibia, fibula | 76 | 4 | 5.3 | 0 |
| Other sites | | | | |
| All cases, excluding hip fractures | 199 | 9 | 4 | 3 |
| Lower extremity, excluding hip fractures | 123 | 8 | 6.5 | 4.9 |

Outside of 11 fatalities in cases of fracture of the femoral neck (a lesion universally attended by a high rate) it should be noted that there were deaths in only two cases, in only one of which bone infection had occurred. Here the bone infection, although of a serious degree, was controlled and, although contributory, was not the primary cause of death. The individual data on postoperative deaths serve to explain the derivation of our gross and corrected operative mortality percentages (Table 3).

Table 3. *Data on 19 Postoperative Deaths*

| Fracture site | Total cases | Range of age | Nonsurgical deaths | Operative deaths | Wound infections |
|---|---|---|---|---|---|
| 1. Femur, neck | 11 | 54–82 | (i.e., after 10 day period; cardiac; apoplexy; etc.) 8 | Shock 1, Pneumonia 1, Pulmonary infarct 1 } 3 | 1—B. Pyocyaneus |
| 2. Femur, shaft | 4 (2 compound) | 47–76 | 2 | Gas gangrene 1, Pneumonia 1 } 2 | 1—Gas gangrene |
| 3. Tibia, fibula | 4 (All compound) | 43–68 | 1 | Shock 2, Fat embolization 1 | 1—Osteomyelitis |

and fixations at other clinics may be derived from the somewhat limited figures currently published.

The Mayo Clinic Fracture Report for 1946 stated that there were four deaths in 136 open reductions for fresh fractures; two were in cases of fractured femoral necks, one in a vertebral fracture, and one in a pelvic fracture. Although most papers dealing with operative treatment in fresh fractures are descriptive and omit extended numerical consideration of their outcomes, many recent papers analyzing end results in compound fractures treated by internal fixation have appeared. The overall impression gained from recent results in compounded fractures in which contamination is anticipated tends to confirm our belief that with present day methods there is relatively small risk of introducing serious infection in fresh simple fractures by careful open operation. In the monograph on internal fixation by Venable

and Stuck, little information concerning the incidence of failure appears, and mortality and morbidity figures are not given.[46] Keon-Cohen reported that in 187 closed cases treated by open operation, five instances of sepsis appeared.[21] All infection cleared after removal of metal and was not considered to have seriously affected the healing of the fractures. Lee stated that in 42 patients treated by open reduction no serious infection was observed, although a number of the fractures were compounded.[22]

In our own series of 185 major simple fractures treated by operation there were five instances of significant or serious infection, with one death. In analyzing our known "complete failure group" we find it most convenient to classify them under the headings of (1) deaths, (2) failures due to infection, and (3) mechanical failures.

The advantages of open reduction over closed treatment cannot be deduced simply and readily from the fact that the former method, at our institution, was accompanied by a lower gross mortality and morbidity. Generally, the gravely injured, the feeble elderly, and the seriously ill are treated conservatively, as befits the group of poorest surgical risks. Consequently the greatest death rate occurs among persons not subject to operation.

*Failures Due to Infection:* These are known cases of major suppurative infection following operation within eight weeks, usually with no appreciable healing of the primary bone or joint injury during the normally expected period. Twenty-two cases are excluded, since the patients were discharged from the hospital without a clinical follow-up or a readmission in less than the minimum two-month observation period when serious acute infection might be expected to occur. The anticipated and frequently encountered slight drainage, which disappears spontaneously in two to eight weeks, or the irritative low-grade osteitis, which clears up when metallic devices are removed after bony union is satisfactory, are not considered here as major complications. It is only in instances of this nature that hardware used for internal fixation is removed routinely by our service. Delayed aseptic necroses of the femoral head, observed in some 20 percent of hip fractures, are excluded for they are not restricted to fractures undergoing operative fixation.[1,2,43,47,48] A summation of our infection failures is given in Table 4, followed by an outline of the pertinent data on individual cases.

Table 4. *Failures Due to Infection in 235 Cases*

| Cases | Major infections | Percent | Died | End Result—Cases | | |
|---|---|---|---|---|---|---|
| | | | | Poor | Fair | Good |
| Total.....235 | 10 | 4.2 | 3 | 2 | 2 | 3 |
| Compound..... 50 | 5 | 10 | 2 | 2 | ..... | 1 |
| Simple.....185 | 5 | 3 | 1 | 1 | 1 | 2 |

*In 185 cases of non-compounded fractures, open reduction was followed by major suppurative infection in three percent with one death. Only in two cases did poor or fatal results appear which were directly due to surgical intervention. This compared quite favorably with operative morbidity and mortality rates in other types of surgery.* Although sulfonamides were used in most cases (penicillin since 1945), the full prophylactic and therapeutic effect of the larger doses of antibiotics available during the past three years cannot be evaluated in this series.

Table 5. *Data on Major Infections*

| Case No. | Injury site | Compounded | Complicating infection | Outcome |
|---|---|---|---|---|
| 1 | Radius, ulna | No | Osteomyelitis | Good results after secondary operation |
| 2 | Radius, ulna | No | Wound infection, osteomeylitis | Fair results after secondary operation |
| 3 | Shoulder joint | No | Supperative arthritis | Poor, partial ankylosis |
| 4 | Femur, neck | No | B. pyocyaneus wound infection | Sepsis, death |
| 5 | Femur, shaft | No | Osteomyelitis | Good functional results after secondary operation |
| 6 | Femur, shaft | Yes | Gas gangrene | Death |
| 7 | Tibia, fibula | Yes | Osteomyelitis | Delayed union, ultimately fair result; nonunion; osteosclerosis; still failure after two bone grafts |
| 8 | Tibia, fibula | Yes | Osteomyelitis | Fair results after secondary operation |
| 9 | Tibia, fibula | Yes | Soft tissue infection | Delayed union; patient died during sequestrectomy 1½ years later |
| 10 | Tibia, fibula | Yes | Osteomyelitis | Good results after secondary operation |

*Mechanical Failures*

| Case No. | Site | Results |
|---|---|---|
| 1 | Tibia, fibula | Complete nonunion |
| 2 | Radius | Marked angulation |
| 3 | Humerus (supracondylar) | Marked displacement |
| 4 | Humerus | Poor alignment |
| 5 | Shoulder | Partial ankylosis |
| 6 | Tibia | Plate broken, successfully replaced |

*Comment*: With the exception of cases one, two, and five, these patients refused corrective secondary procedures. In the interim they may have had surgical revision elsewhere.

Mechanical failures in any large series appear to be inevitable, but fortunately occur relatively seldom.

INTERNAL FIXATION IN COMPOUND FRACTURES

The relative merits of open versus closed treatment of compound fractures are still unsettled. More and more writers have reported and defended more cases of compound fracture treatment by prompt debridement, open reduction and immediate closure. Their published recommendations still reflect a considerable variance of opinion. Smyth and Ravieri[39] advocated internal fixation but without primary closure, preferring the Orr method for four weeks (a sterile petrolatum gauze pack and closed circular encasement). In penetrating joint injuries they, as well as Thomson and Berry[44] recommended a thorough exploratory arthrotomy and removal of all devitalized tissue and debris, followed by a final water-tight closure of the joint capsules.

Many recent reports on the treatment of fractures, emanating from military medical sources, attempt to analyze standardized procedures used in a large number of cases. However, these methods must be compared with methods used in civilian practice.

In metropolitan hospital experience adequate surgical facilities are more easily available, thus accommodating patients for any required period of follow-up observation by the original operating teams. Also, civilian patients generally are operated on only after treatment for shock and hemorrhage. Gunshot wounds are rarely a cause of compound fractures in civilian life. In contrast with both rural and battlefield practice, soil contamination is less, and the risk of tetanus or gas infection almost negligible.

Judged from the more truly comparable case series reported by civilian surgeons from cities of moderate or large populations, the proper early internal fixation of compounded fractures in selected cases is attended by little risk and results, as a rule, in earlier ambulation and restoration of function. Hampton has emphasized the contrast between compound wartime and civilian fractures.[16] He stated that in 41 percent of 168 cases, in which briefly delayed internal fixation of compound battle fractures was performed, sequestration resulted. Often the infections were grave, sequestrations massive, and grafting required. Collow and Erving[7] reported that in 23 of 24 cases of internal fixation of compounded fractures of the femoral shaft, good results were obtained with primary closure. Burnes and Young[4] in a series of 70 nonmilitary cases of compound fractured femur reported similar results. Those authors utilized penicillin in controlling invasive infection.

Davis,[11] in discussing 150 cases of compound fractures, of which some 80 were major fractures involving the long bones, likewise concludes that internal fixation and primary closure constitute the optimum treatment. He indicated that this has become true particularly since 1942, with the advent of sulfonamides, antibiotics, blood banks, high protein-vitamin dietary supplements and routinized skin and bone grafts, as well as the development of inert non-irritating metallic fixation devices. In his series, 87 percent of the patients were healed by first intention. In 13 cases (8.5 percent) there was superficial infection. In one plated tibia he encountered a complete failure, with osteomyelitis followed by plate removal and bone-grafting, with persistent nonunion. Four deaths resulted from 80 cases of major fractures and apparently six instances of serious infection. One fatality was in a case of gas gangrene, the patient having been injured while in country surroundings.

Fig. 4A. Five-month-old unreduced Monteggia fracture with malunion.

Fig. 4B. Result six months after secondary operative reduction and fixation. Radiohumeral dislocation corrected, function of elbow unimpaired.

Fig. 5A. Comminuted compression T fracture of both condyles of tibia and head of fibula, involving articulation.

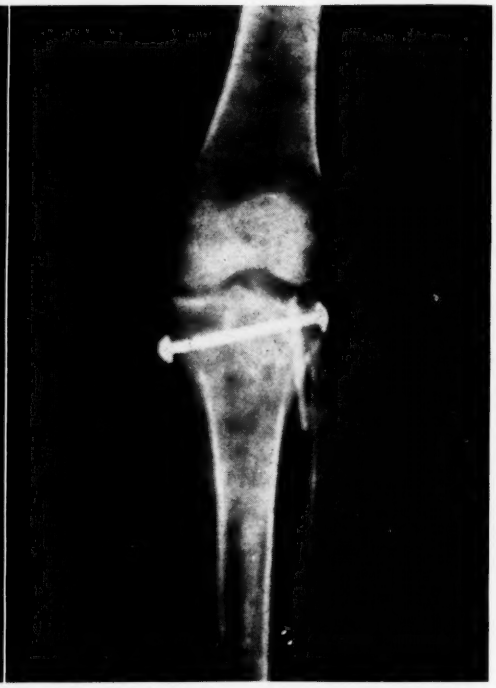


Fig. 5B. Results eight months after operation using bar bolt and sliver graft to restore joint contour. Knee function satisfactory, no limp.

Stimson,[36] in reviewing 65 cases, also found that compound fractures of femur and tibia shafts, suitably selected and properly plated, are best treated by internal fixation. In this group there were seven deaths, one amputation, two instances of nonunion, and 11 instances of sequestrectomy. However, these complications and fatalities occurred prior to 1932. Stimson stated that areas of erosion of bone around improperly applied screws may serve as a potential source of infection. This is prevented by securing sufficient rigidity via internal fixation to obviate torsion strain and means that an adequate plate length, supplemented by one or more transfixion screws, is needed. Keon-Cohen[21] included in his report 47 cases of compound fracture treated by internal fixation. Of these, 34 were healed by first intention and eight after minor degrees of superficial skin sloughing. In five patients significant and serious sepsis developed.

Joldersma[19] expressed another opinion in reporting on a series of 32 simple tibial and femoral fractures by bone plating. He did not plate compounded fractures. Lee[22] also described no instances of sepsis in 18 compounded fractures subjected to immediate debridement, internal fixation, and primary closure.

In our series we have excluded both compound and simple fractures of small bones of the hands and feet, since the majority of the patients were ambulatory and hospitalized for short periods only, and since a large number did not return to the clinic for follow-up care and observation.

A group of 14 compounded fractures about the head were treated on our service during the same period. In no instance did serious bony infection occur in these cases, although three patients were treated prior to our utilization of penicillin. Five of these had a relatively

Fig. 6A. Fracture of femoral shaft with distractive nonunion.

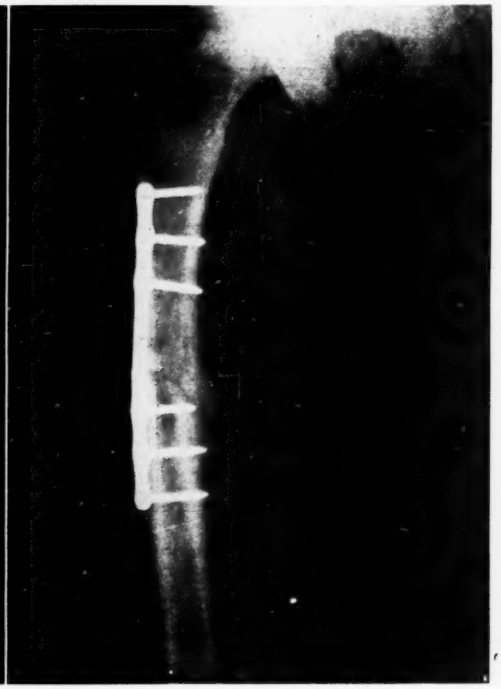


Fig. 6B. Five months after operation, gait and weight bearing unimpaired.

serious head injuries and concussion phenomena, four had noncompounded basilar skull fractures of the vault; two had compounded fractures of the mandible, and seven had compounded comminuted fractures of the nasal bones, in two of which the accessory nasal sinusus were involved. Cases of compounded skull fracture requiring anything other than simple bone elevation or extensive neurosurgical procedures are not included, since such injuries are transferred to other services for definitive treatment.

Table six shows our experience with compound fractures treated by open reduction. The majority of the failures (deaths and infections) occurred in early years of the series and in the most seriously injured patients. The great variation in extent of injury in persons sustaining compound fractures militates against any strict comparisons from series to series. The violence of the injuring forces and the nature of concomitant organic injury or the multiplicity of wounds, i. e., the varying severity of trauma sustained in individual cases, rather than the therapeutic program—may in large measure determine the end results.

### FRACTURES OF THE UPPER EXTREMITIES

*Fractures of the Humerus:* The popularization since 1933 of Caldwell's hanging cast has reduced considerably the indications for open reduction and internal fixation in humeral fractures. In certain types of fractures of the upper end of the humerus, the traction of the hanging cast may fail to facilitate the return of the displaced fragments to normal position. In such instances, open reduction and internal fixation are advantageous. Avulsion fractures of the greater tuberosity of the humerus, if poorly reduced, will be followed by impairment of the abductive action of the supra-

Table 6. *The Compound Fracture*
An analysis of experience with 53 cases treated by debridement and open reduction.

| Site | No. Cases | International fixation | Complications |
|---|---|---|---|
| Humerus | 2 | 2 | None |
| Radius, ulna | 11 | 6 | 2 moderate infections (healed without further surgical treatment) |
| Femur, shaft | 8 (2 bilateral) | 8 | 1 operative death (gas gangrene) |
| Tibia, fibula | 31 (2 bilateral) | 24 | 3 operative deaths<br>4 major infections<br>1 healed without surgery<br>2 required sequestrectomy<br>1 nonunion with osteosclerosis, repeated operation unsuccessful |

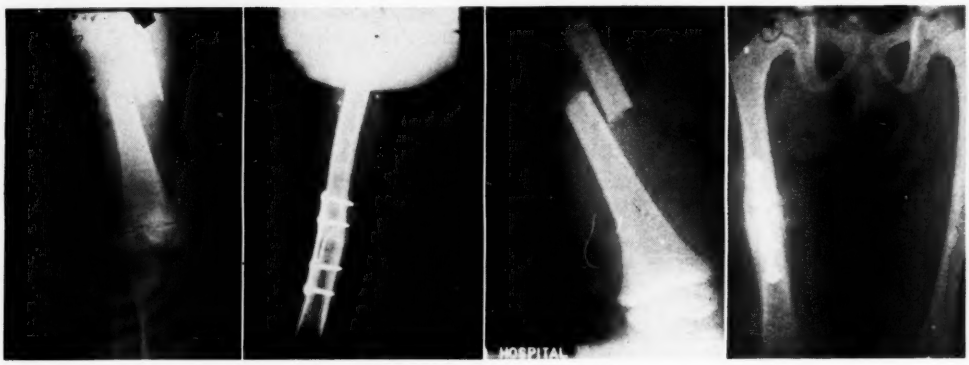
spinatus muscle of the shoulder. In fractures of the surgical neck of the humerus (when accompanied by dislocation of the shoulder joint) it is sometimes necessary to explore, reduce the dislocation, and immobilize the fragments by screw transfixion. Fractures of the midshaft of the humerus require internal fixation only infrequently.

Operative treatment is indicated for the compound fracture and may be warranted in cases of extensive comminution. Muscle interposition between bone ends or injury to radial nerve is a mandatory indication for surgical intervention. Supracondylar fractures of the humerus, most frequent in children, fortunately are usually reducible by direct manipulation. When malposition cannot be corrected, accurate bone realignment and internal fixation are indicated. Fractures of the internal or external humeral condyles, when grossly displaced, may require the precise anatomic reduction obtainable via open reduction methods in order to prevent damage and functional impairment of the elbow joint or injury to the radial or ulnar nerves.

*Fractures of the Forearm:* Not infrequently fractures of the olecranon require operative treatment. Oblique fractures of both radius and ulna are often difficult to control by conservative measures. If the fragments cannot be impacted in satisfactory position, internal fixation is indicated. The Monteggia fracture (a spiral fracture of the upper third of the ulnar shaft accompanied by dislocation of the head of the radius) can seldom be managed by closed manipulation, consequently operative reduction has become the accepted initial treatment in this type of fracture. In fractures of the radial head with displacement, myositis ossificans in the past has been a frequent complication when treatment was conservative. Excision of the radial head has been regarded recently as a satisfactory method of management.

### FRACTURES OF THE LOWER EXTREMITIES

*Fractures of the Hip:* When the condition of the patient warrants it, hip nailing is now the usual form of treatment at our institution. The Smith-Peterson nail is most frequently utilized for femoral neck fractures; a Jewett or a similar nailing device is preferred in intertrochanteric fractures. Generally the fracture is reduced preoperatively by suitably directed traction and manipulation reduction being maintained by the manual traction of an assistant during the actual operation. A six-inch incision generally suffices for exploration and reduction and, in our hands, surpasses the so-called blind or percutaneous methods of



A B C D

Fig. 7A, B, C. and D. Examples of transverse fractures of femurs in children, unstable after traction and manipulation reduction. Satisfactory reduction and end results with internal fixation.

hip nailing. Nail position is controlled by anteroposterior and lateral roentgenograms. Patients are propped up in bed and encouraged to use an overhead trapeze, but as a rule are kept in bed for three weeks. Since these fractures almost invariably occur in elderly patients, blood transfusions are introduced to prevent shock.

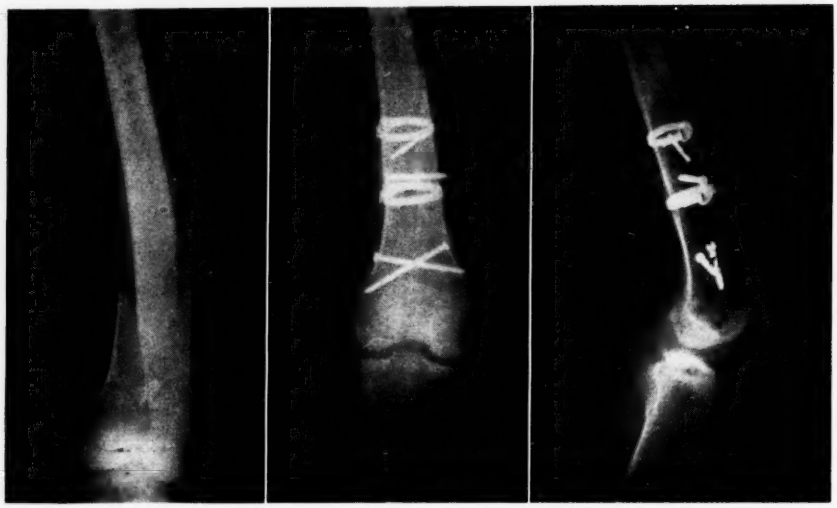
*Fractures of the Femoral Shaft:* Because of the powerful displacing muscle forces, where there are insufficient retaining serrations of the fragment ends, angulation and shortening may ensue. The average hospital internment for patients with femoral shaft fractures treated by traction methods is from nine to 11 weeks. Occasionally, when early ambulation is warranted, elective open reduction is employed. When the fracture is transverse, and therefore reduction is unstable, or where soft tissue is interposed (or in compound injuries) primary open reduction and internal fixation are indicated. In our usual technic a Lane plate is used.

The Kunschner intramedullary nail, an apparatus successfully used by other workers,[28, 40] has not been used in this series, although in certain instances various other forms of intramedullary bone or metal pegging have been employed. The Kunschner nail, offers no notable advantages over plating, screw transfixation, or Parham bands for internal fixation of long bones. The obvious operative difficulty of removing a large intramedullary metallic rod should infection or any other untoward complication ensue, is a notable disadvantage, unless provided against.

*Fractures of the Knee, Leg, and Ankle:* Condylar fractures of the femur that cannot be properly replaced by traction and manipulation often require internal fixation to restore the normal joint line. Usually the insertion of two or more screws of sufficient length at oblique angles to each other suffices. Fractures of the patella, when there is wide separation of the fragments, are satisfactorily treated by open reduction and internal fixation, generally by wiring, which attempts to ensure satisfactory function of the quadriceps muscle.

*Fractures of the Tibial Plateau:* Current literature indicates that the well known delayed union and far too common nonunion of the lower third of the tibia, may be prevented by early internal fixation[21, 22, 25, 34, 40, 48]. Our experience corroborates this finding. Comparative reports of fractures treated by internal fixation and by traction concerning oblique and comminuted fractures of the lower leg outnumber studies regarding other such injuries. The majority of recent reports agree that operative reduction with direct fixation is the preferred treatment, for it offers simpler management and better results over a shorter period.

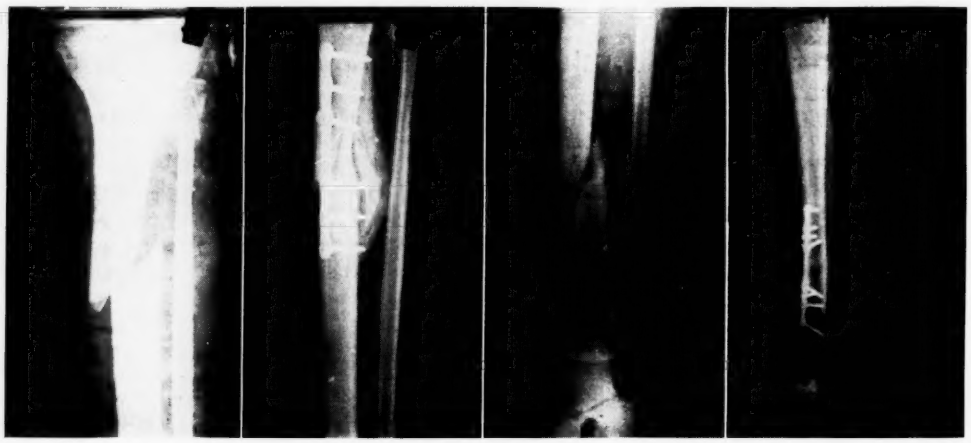
In fractures of the tibial plateau, with any marked degree of depression of the condylar[2] fragment, great care must be taken with regard to anatomic realignment, lest the knee



A B C

Figs. 8A, B, C. Compound comminuted supracondylar fracture of femur. Postreduction plates one year later. Note restoration of anatomical alignment and absence of excess callus.

joint become unstable. If the semilunar cartilages are damaged, they are excised. Since the bone is cancellous at this level, large screws must be used. In our hands the transverse Barr bolt, passing through both condyles and providing some degree of compression force has on occasion, proven invaluable. Previously, we have presented a conservative method of managing trimalleolar fractures by means of a distraction apparatus and transfixion pins, embedded in plaster for immobilization once reduction is attained. Fractures of this type,



A B C D

Figs. 9A, B. Examples of fractures of tibia treated by internal fixation. In the first case, iliac graft and plate were used. Ultimate results were satisfactory in both cases.

in which malposition cannot be corrected by conservative measures, may respond to open reduction. Primarily this may be needed where there are separation of the inferior tibiofibular ligament and marked disorganization of the ankle mortise with irreducible displacement of the medial and lateral malleoli. In ununited fractures of the internal malleolus, instability of the ankle inevitably follows and is an indication for operative reduction and internal fixation. In the majority of fractures about the ankle requiring operative treatment, screw transfixtion is the method of choice.

### TREATMENT OF MALUNION, NONUNION AND INFECTED FRACTURES

Cases of fracture and joint injury in which primary treatment has failed can be defined as those in which malunion, nonunion, or osteomyelitits has supervened. We include cases that have come to this end after both open and closed methods of initial therapy. An exhaustive treatment of management in such disasters is not our purpose, but we propose to summarize a number of personal impressions in the past five years which agree with numerous authors,[1, 2, 17, 26, 32, 35, 43] and constitute a rather definite revision of earlier opinions.

For corrective secondary procedures, the patients must be good operative risks no less than for primary internal fixations. Poor results in open reduction may be due to infection and contamination or impared healing potentialities in debilitated patients just as well as to poor anatomic alignment and inadequate fixation. Restorative procedures to correct hypoproteinemia and anemia (such as may be attendant upon chronic draining sinuses or found in elderly debilitated persons long bedridden by unhealed fractures) are common basic prerequisites.

In both acute and chronic postoperative infections involving bones, McCorkle,[26] Buchman and Blair,[3] Farrow,[21A] Hailey,[17] and his associates, and Reynolds and Zaepfel[35] have established the fact that chemotherapeutic and antibiotic agents have made possible a direct operative osteosynthysis by means of bone grafts or metallic fixation devices where such procedures would have led to inevitable disaster and overwhelming infection only a decade ago. This does not obviate the necessity, as indicated, for debridement, sequestrectomy, saucerization, and the obliteration of dead space. Penicillin alone cannot succeed in bringing about healing if necrotic tissue remains in the wound. However, systemic antibiotic therapy is effective in controlling infection after adequate operative treatment has removed all necrotic tissue and noxious foreign material.

A number of workers[3, 5, 17, 26, 35] have had the opportunity to survey and report upon many instances of such secondary operations in the presence of chronic osteomyelitis in which, with penicillin administered in large doses over a prolonged period, healing has been *per primum*. In approximately three-quarters of the cases reported (the various series published now total several hundred) good final results have been achieved, and the value of this method is well established.

Our concept of what constitutes union agrees with that of Bick[6] and Venable,[46] who emphasize that the usual x-ray criterion of acceptable bone healing (exuberant external callus formation) need not apply to fractures following internal fixation. Bick postulates that a translucent internal callus, explaining the visualization of the fracture lines long after the patient is funtionally healed, is to be welcomed. In his opinion the appearance of massive external callus is an indication that the artificial support of the plates and screws is inadequate. We have observed a number of cases which substantiate this viewpoint, and we have illustrated several of them in the accompanying figures and legends. Impressed with the absolute indispensability of rigid fixation, we adhere to the dictum that "the minimum of hardware be utilized in a given case" only so far as it is consistent with the securing of rigid immobilization of fracture fragments.

In the utilization of bone grafts we have recently employed segments of the iliac crest in a number of instances and found them to be as effective as tibial donations. Iliac grafts are advantageous in that cancellous bone is provided, which has the property of earlier reparative osteogenic proliferation than his cortical tibial bone. It also shows earlier amalgamation and fusion with adjacent recipient osseous structures.

In addition to freshening bone ends in in-

stances of nonunion, opening of the medullary canal and multiple drilling appear helpful. When an initial plating has failed we have replated in several cases (at times as a supplement to bone grafting) and have achieved a successful outcome. In malunion of the long bones productive of shortening deformity, or sufficient angulation to interfere with proper muscle and joint action, corrective osteotomy should be resorted to promptly. In onlay bone grafts sometimes we have performed only periosteal stripping, as advocated by Phemister,[32] and depended upon fixation of the graft by soft tissue suture. More often, in agreement with Bishop[5] and his coworkers, we prefer to remove an intermediate thickness of cortex in preparation of the graft bed and in addition use bone plates and screws when necessary to secure rigid fixation of fragments and grafts.

In fractures of the femoral neck, from which poor end results may be expected in almost one-third of the cases, largely owing to aseptic necrosis and absorption of the head of the bone, we have depended upon some modification of the McMurray osteotomy of palliative correction in unsatisfactory healing, and have, in a number of cases, been gratified by the improvement attained.

SUMMARY

Open operative treatment of 257 consecutive, unselected major fractures and joint injuries, treated at a municipal hospital from 1942 through 1947, are reviewed and analyzed. In this series 185 major simple fractures were surgically treated including five instances of serious bone infection, with one death. This compares favorably with operative morbidity and mortality rates in other types of surgery.

The routine operative treatment for fractures is not advocated. However, with a decreased risk of infection now achievable, a finding corroborated by the recent literature, elective indications have been amplified. Cocepts of open versus closed treatment of fractures are revaluated in the light of such recent adjuvants in operative care as improved anesthesia, antibiotics, chemotherapy, transfusions, and protein replacement therapy.

Certain advantages of operative fixation over the older traction or closed reduction-immobilization methods of treatment are outlined. The early resumption of motion to preserve the tone and function of soft tissues and the mobility of articulations is considered as an increasingly important desideratum.

The indications for open reduction, the requisite surgical fundamentals, and an analysis of complications and failures are presented. The use of internal fixation in compound fractures is discussed and end results in non military cases contrasted with those following battle injuries. Statistical comparisons are given to substantiate our conclusion that in civilian metropolitan life the proper early internal fixation of simple or compound major fractures, in selected cases, is attended by relatively little risk and achieves as a rule earlier ambulation and restoration of function.

RIASSUNTO

Passa in rassegna ed analizza 257 casi di estese fratture e di lesioni articolari occorsi consecutivamente dal 1942 al 1947 in un ospedale comunale. 185 fratture semplici sono state curate chirurgicamente: in 5 casi si è stabilita una grave infezione ossea, con un caso di morte. Questa percentuale è modesta, se confrontata con la morbilità e la mortalità di altri tipi di interventi.

L'A. non ritiene tuttavia che tutte le fratture debbano essere sottoposte ad un'operazione. Traendo vantaggio dagli attuali mezzi chemioterapici e dagli antibiotici, dai perfezionamenti conseguiti nell'anestesia; dall'impiego sempre più frequente delle transfusioni e dalla terapia sostitutiva delle proteine, l'A. si limita a propugnare una piu' larga adozione di questo tipo di cura.

Pone in evidenza taluni vantaggi delle fissazioni operative sopra i vecchi metodi di riduzione e di trazione: sottolinea particolarmente i vantaggi di una più rapida ripresa dei movimenti, onde preservare il tono e la funzione dei tessuti molli e la mobilità delle articolazioni.

Discute le indicazioni per una riduzione operativa e le basi tecniche dei singoli interventi: analizza le possibili complicazioni e le cause degli insuccessi. Confronta in ultimo le statistche operative militari e civili. Da questo confronto risulta che la fissazione operativa delle fratture semplici o comminute, eseguita precocemente in casi selezionati, espone a

pochi periocoli mentre conduce ad una più rapida ripresa della deambulaziones e ad un completo ripristino funzionale degli arti colpiti.

SUMARIO

Hemos presentado un analisis de nuestras experiencias en el tratamiento por la intervencion cruenta de 257 casos consecutivos y no seleccionados de fracturas mayores de los huesos y de traumatismos articularios, que se presentaron en un hospital municipal en los anos de 1942 a 1947. De 185 casos de fracturas mayores simples que fueron tratados operatoriamente (intervencion cruenta), solo cinco casas sufrieron de infeccion osea grave, y solo uno termino fatalmente. Este resultado se puede comparar favorablemente con los indices de morbilidad y de nortalidad que encontramos en los analysis de las estadisticas de otros tipos de intervencion quirurjica.

Aunque no se aconseja e" como metodo de rutina la intervencion cruenta en el tratamiento de las fracturas, hemos amplificado sus indicaciones electivas. Debido a los adjuvantes modernos en manos del cirujano, como los antibioticos, la quemoterapia, la anestesia moderna, y las transfuciones proteinicas y de sangre, ha sido posible hacer una revaluacion de nuestros conceptos sobre la intervencion cruenta (operatoria) en relacion con los metodos de reduccion no cruentos (cerrados) Se han descrito ciertas de las ventajas de la fijacion operatoria sobre los metodos mas antiguos de reduccion e inmobilizacion. La ambulacion temprana del paciente con mocion de la parte fracturada mantiene el tono normal y la funcion de los tejidos y de las articulaciones. Estos desideratis adquieren mayor importancia en la seleccion del metodo de tratamiento.

Las indicaciones de la intervencion cruenta han sido presentados en relacion con los requisitos fundamentales de este tratamiento, asi como tambien se ha presentado un analysis de sus complicaciones y de los fracasos incidentes a este tratamiento.

El uso de la inmobilizacion interna en las fracturas abiertas ha sido discutido y se han comparado los resultados obtenidos entre los casos civiles y militares. Los autores concluyen que en los casos civiles el tratamiento por fijacion interna de las fractures simples y compuestas en casos seleccionados favorece la rapida ambulacion y restauracion de las funciones normales del paciente.

SOMMAIRE

Le traitement opératoire ouvert de 257 cas consécutifs de fractures graves et de lésions articulaires, traités à l'hospital municipal entre 1942 et 1947, est passée en revue et analysée. Dans cette série, 185 fractures simples majeures furent traitées opératoirement et aussi five cas d'infection osseuse. Il y eut I décès. Les résultats se comparent favorablement avec le taux de morbidité et de mortalité d'autres cas chirurgicaux.

Le traitement opératoire routinier des fractures n'est pas préconisé. De nos jours les dangers d'infection etant diminués, les indications particulieres ont été augmentées. L'auteur compare le traitement ouvert et fèrmé. Le traitement ouvert des fractures doit être reconsideré, vu les progrès de l'anesthésie, des'antibiotiques, de la chîmothérapie, des transfusions et de la thérapenfique bat les proteine.

Certains avantages deffixations opératoires sur la vieille traction et sur le traitement par réduction et immobilisation sont décrits. La pratique de la mobilisation pour préserver le tonueset la fonction des tissus mous et la mobilité des articulations est considérée comme de grande importance. Les indications pour la réduction ouverte, les connaissances, chirurgicales requises, l'analyse des complications des échecs sont presenteés l'emploi des fixations internes dans les fractures, ouvertes, sont discuteés ainsi que les résultats obtenus.

Des comparaisons de statistiques sont données pour appuyer les conclusions de l'auteur: que dans les grandes métropoles, la fixation interne précoce des os fracturés, fermée ou ouverte, est accompagnée de peu de risques et obtient une ambulation et une restauration des fonctions plus rapidement que les anciennes méthodes.

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# Automammaplasty*

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AUTOMAMMAPLASTY is the total reconstruction of the breast from the individual's own tissue, or more specifically, the formation of a second breast from a single remaining breast, and should demand our attention because society today is being alerted constantly to the menace of cancer.

Daily there appear articles in medical journals and in the lay press warning of the tragedies that the disease brings. During the past 10 years, a tremendous amount of research has been done on the subject. Recently, through newspaper, magazine, and radio publicity, further impetus has been given to investigations in the field. This, in addition to educational programs of various medical associations, has made the layman "cancer-conscious."

Cancer of the female breast has been of special concern to investigators for many years. The reason for this is, that cancer of the breast is, by far, the greatest cause of mortality and morbidity, insofar as the female is concerned. Cancer of the breast plays no favorites as to age. However, its frequency of occurrence may be classified into three general age groups. In order of diminishing frequency, these age groups are: first, of greatest frequency, from the age of puberty to about 40, or during the usual childbearing age: second, during the menopausal age from 40 to about 55; third, and least frequent, in the involutional stage from 55 on.

In the past few years there has been an increase in the number of cancer cases. This increase, however, is "apparent." I say "apparent" advisedly. Due to wide publicity given the subject of cancer, many more women come earlier and more often for periodic examinations. Thus, many more malignancies are discovered.

We have learned that a biopsy should be made of every suspicious nodule found in the breast. Because of the frequency of biopsies, many early cancers are discovered. Since there have been so many younger females who have had breast biopsies, many more young girls have been subjected to radical breast amputations.

It is customary in nearly all modern institutions for a biopsy to be done of all lesions before a radical amputation is performed. The type of biopsy varies with the surgeon. Some do a needle or punch biopsy, while others do a frozen section on an excised gland.

Needless to state, no matter what type biopsy is done, there is a possibility of error, which varies according to the type of biopsy performed. Of course, punch or needle biopsies are subject to greater error than are those done by direct excision. Rapid frozen sections are also subject to technical errors as well, as to the experience and ability of the pathologist. Many of you, doubtless, have had one report on a frozen section which was followed, in a few days, by a contradicting diagnosis based upon a paraffin section. The error might have been in the selection of different parts of the same specimen, in poor staining or detail of the frozen section, or it might be due to erroneous diagnosis of the first specimen. Unfortunately, complete resections are done frequently on the basis of such misjudgment. The patient, of course, is left with one breast.

The pathological report may justify the radical resection. The histologic picture of the tumor corresponding to grade two shows that 66 per cent of the cases result in a five-year cure. Grade three tumors show five-year cures in 28 percent of the cases. In a series of 94 cases of cancer of the breast, subjected to complete operation, 45 percent showed a five-year cure, according to L. Clarence Cohn. Five-year cures approaching 90 percent can be expected from treatment by radical operation for patients harboring grade one tumors.

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Simmons has made an analysis of a group of 84 patients who presented axillary nodes clinically. In 72 of these cases, cancer was proved by pathological examination, while in 12 cases, the nodes were inflammatory. This is an error in original diagnosis of 14 percent. It was indicated by this analysis that cases of cancer of the breast in which the axillary nodes are not diseased, patients living without clinical evidence of cancer, may be considered permanent cures at the end of five years. But, in patients with positive nodes at the time of operation, 19 percent will die of recurrence by the end of five years.

The frequency with which benign tumors account for radical mastectomies is impossible to estimate. Difference of medical opinion as to the classification of such conditions as "hyperplasia of duct epithelium" or "atypical hyperplasia in lobules" as transitional changes or early stages in malignancies, also account for a large number of breastless women.

Whatever may be the cause for radical resection, it must be noted that in a good percentage of cases, these women have a life expectancy of at least five years, and in some instances, an expectancy of 10 or 15 years.

The reaction of women to radical breast surgery varies greatly. Some women find this fate in life unbearable, and their emotional reaction turns them into seriously maladjusted persons. Quite often, domestic relations are affected to the point of separation and divorce.

In the majority of cases, loss of one breast does not affect the individual in such a serious manner. These women usually resort to the use of some type of fabricated material, shaped in the form of a breast, manufactured by many brassiere companies, or the latex or sponge rubber prosthesis described by Adolph Brown, of Chicago. These artificial replacements are employed for several reasons: first, the device gives the woman symmetry; secondly, they provide a foundation upon which to wear clothes; thirdly, the replacements lessen psychological factors such as mental depression, neuroses, and inferiority complexes; fourthly, these devices are inexpensive. But have you ever spoken to a woman who wears falsies?

Some women do not react to the mental shock as greatly as they do to physical. Many women normally have large, hypertrophied breasts. When these women lose one breast, they become top-heavy on the normal side. The weight of this side produces a pain on the opposite side, due to the attempt of the individual to maintain her balance.

Much has been written concerning plastic surgery of the breast. This material has dealt primarily with surgery to increase the size of the breast, or surgical techniques for reduction of hypertrophied breasts. Where there was asymmetry in the two breasts or where the breasts were infantile in type, procedures such as the injection of paraffin (long obsolete) or the introduction of fat grafts have been used.

However, little attention has been given to the reconstruction of the breast where there is complete absence of one of the breasts owing to injury or surgery. This is due, perhaps, to the fact that many of our conferees have felt that the span of time between the original surgery and the terminus was not sufficiently long to warrant the effort or expense. It may also have been felt that knowledge of the technic, up to this time, was limited or unsatisfactorily developed to warrant the risk of reconstruction.

It has already been stated that there has been, in the past few years, a significant increase in the number of women undergoing complete resections of the breast. The trend will probably continue. Also it has been shown that many of these women have breasts removed which show a low-grade malignancy, or no malignancy whatsoever, and consequently have an increased life span following resection. Too, improvement in technique and operative thoroughness has increased the time interval of five and 10-year cures.

With these facts in mind, I should like to state that when the evidence in the case proves the necessity for treatment, and when the proper tissues are available, I am of the opinion, that the patient is entitled to any and all procedures, whether they be medicinal, physical, psychical, surgical, or all combined, in order to give the individual a brighter outlook on life. The remainder of this paper is concerned with a procedure of automam-

maplasty which lends itself to relatively safe and universal employment towards this end.

Literature on automammaplasty has been perused thoroughly. The sole description of such an operation is one described by Max Thorek in his book *Plastic Surgery of the Breast and Abdominal Wall* which includes photographs and details of the operation performed by Wilhelm Reinhardt. This shows a bisection of the breast and describes in stages, the transplantation of the medial half of the breast, to the opposite side. Five stages were employed to form the new breast.

A careful analysis of this procedure shows it to be based upon the principle of transference of a single, open pedicle flap. Under certain qualifying circumstances this would be suitable and, to date, with no other information available, would be justifiable. It does, however, have several disadvantages.

1. The one remaining breast is immediately disfigured. Both halves become endangered and there is the possibility that both halves may not survive.

2. The operation would be satisfactory only where there is a small pedunculated breast.

3. When the open pedicle flap is employed, there is the danger of secondary infection.

4. The pedicle flap, composed of gland and fat tissues, is a compound pedicle and is subject to the danger of an unconditioned circulation and the difficulties which such tissues have in adjusting themselves.

The technic of automammaplasty which this paper proposes may be used for round, pedunculated, small, or large breasts. The number of major procedures are limited to six. The danger of slough is avoided because multiple pedicles are employed. The tubular arrangement of the pedicles prevents the danger of secondary infection and shrinkage. And, with this procedure, one reconstructs the remaining breast first, thereby assuring the patient of having one good breast even in the event of failure in the reconstruction of the second breast.

Following is the history relevant to the case under discussion. A patient was referred to the Plastic Clinic from the Cancer Clinic of the White Memorial Hospital, Los Angeles, which is associated with the College of Medical Evangelists.

The patient, 36 years old, had had a breast removed to eliminate a grade two tumor. Healing was normal, and she had good, adequate covering of the affected side. The patient was extremely unhappy because of her disfigurement. Her carriage was poor owing to a constant pull on the right side. She could not dress well. The remaining breast was very large and heavy. Psychologically, she was morose, depressed, and had a severe inferiority complex.

When the patient appeared at the Plastic Clinic, her physical condition was thoroughly checked. Figures were cited to her with respect to the percentage of recurrences, and the number of years of life expectancy were given her.

The dominant concern of the patient was to have her remaining large breast reduced. Also, she showed much interest in the possibility of having another breast constructed, and she inquired about the feasibility of such a procedure. The information given her at that time, relative to automammaplasty, was a description of the Reinhardt technic. The possibility of failure of both sides was explained to her. Since she was already miserable over the loss of one breast, this prospect increased her apprehension. An alternative proposed to her was the reconstruction of the remaining breast to make it smaller. It was suggested that she think the matter through carefully.

In the meantime, I devoted considerable time in an effort to discover a procedure which would assure readjustment of the one breast and also make possible the formation of a new breast from the discarded tissue.

The following is a step-by-step description of the technic which was devised:

### STAGE ONE

Markings are placed on the normal breast. The location of the new areola depends upon the height, weight, and the size of the thorax. A simple, safe, all around general rule, would be to drop a vertical line from the center of the clavicle, to the chest wall. A point six to seven inches from the clavicle, is marked on this line. Then with the Acromion Process as

a fixed point, and the radius of six to seven inches, markings are placed at the intersection of this point. With the sternoclavicular articulation as a center, with the same radius, another mark is made. The intersection of these three lines, determines the midpoint of the new areola.

Using the ordinary nipple lead shield, a circular marking is made, with the nipple as

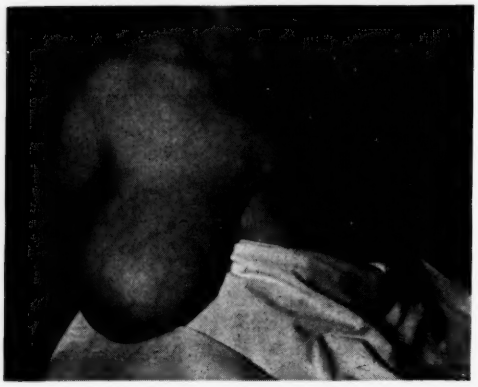

Fig. 1. Front view before surgery. Shows the appearance of the remaining breast after radical mastectomy. Note the hugeness of the breast.

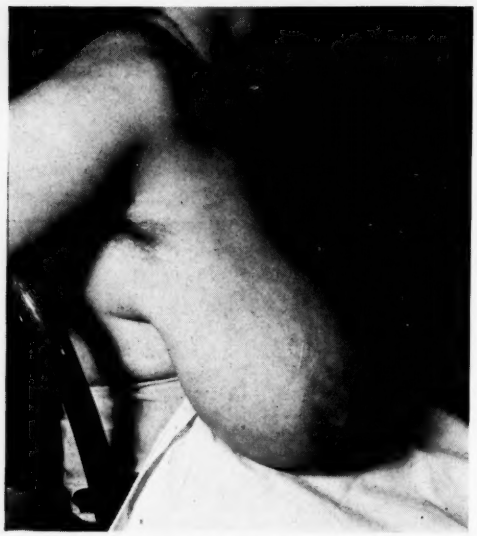

Fig. 2. Side view before surgery.

Fig. 3. Markings of breast before surgery. (1) Location of the new areola. (2) Markings around the original nipple. Inner circle shows size of newly formed areola on old breast. The second circular incision shows width of flaps. (3) Shows incision on each side extending from areola flaps to medial side. (4) Shows the anterior flap.

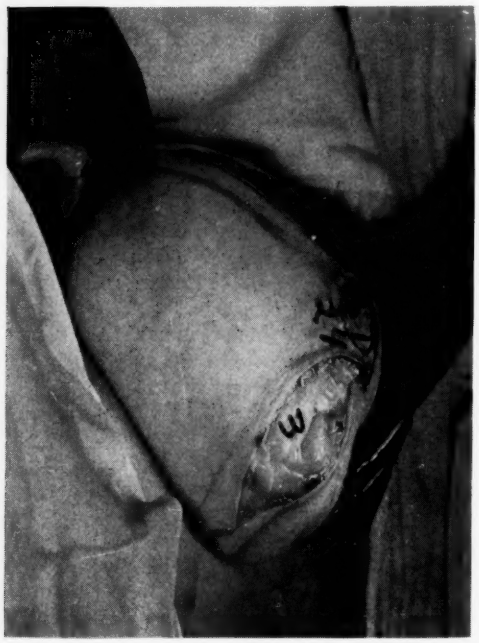

Fig. 4. (1) Shows the areola has been circumscribed. (2) Shows four interrupted silk sutures fastening the margins of the areola to the mammary fascia. (3) Incision has been made thru the skin and superficial fascia on each side. Note: mammary fat protruding. (4) Shows the areolar flaps attached to the segment of the breast.

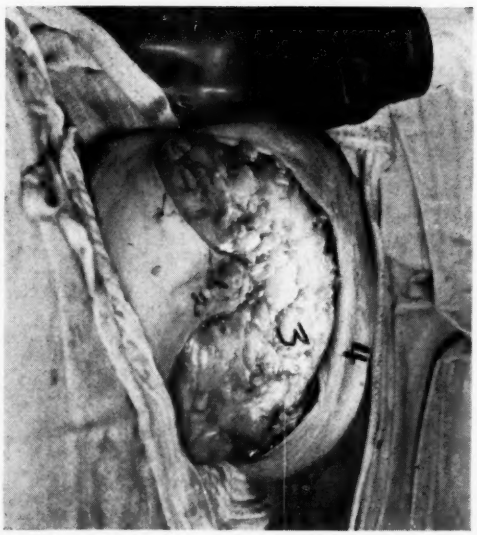

Fig. 5. (1) Shows the old areola and nipple. (2) Shows the areolar flaps which will form the new areola. (3) Breast tissue which has been separated. (4) The upper part of the skin and subcutaneous tissue of original breast.

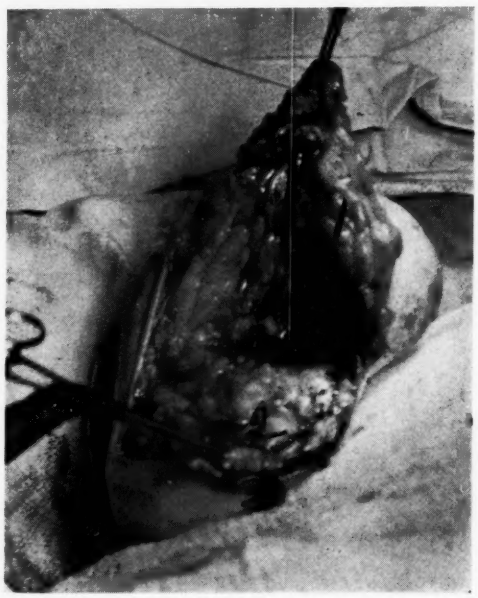

Fig. 6. (1) Shows upper half of original breast with the original nipple attached but the outside of its skin covering. (2) The lower half of the original breast with its original skin covering intact. (3) The areolar flaps free.

a center. A small medicine glass may be used, or free hand marking. The size of these marks, must be judged according to the amount of areola present, and to the size of the future breast. The next marking about the areola, includes all of the remainder of the areola, and is in the form of an inverted U. The arms of the inverted U, passing to the lateral and medial sides of the breast. Another line is made, parallel to the last medial and lateral lines.

The assistant then holds the breast, in the form of a cone, and the incision following the first, or central marking about the nipple is made. When the cut reaches the mammary fascia, the tissues will retract. Four interrupted silk sutures are then placed about the areola, fixing the areola to the mammary fascia, to prevent injury to this tissue.

The next incision follows the second areolar marking, and extends to the lateral and medial markings, of the upper of the two parallel

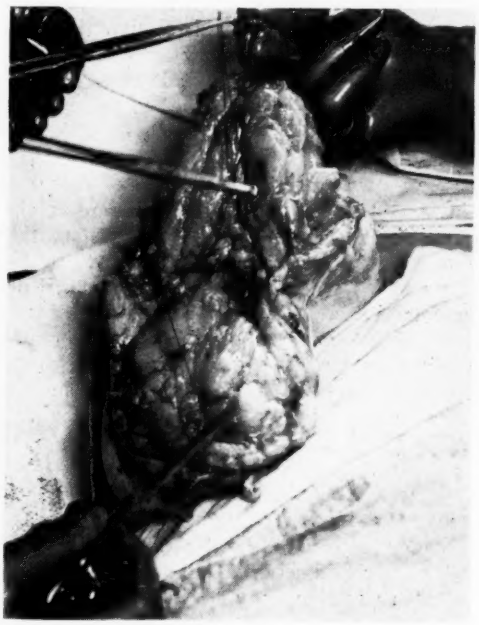

Fig. 7. Shows the reconstruction of the remainder of old breast into a new and smaller one by the formation of a cone. It is at this time when the desired size is established. Raw margins are sutured to each other and the base is sutured to the pectoral fascia.

Fig. 8. Side view of Fig. 7.

lines. This incision extends through the skin and fascia, to the mammary fat.

The skin over the upper half of the breast is separated from the breast structure, by blunt dissection, with a lap sponge. This dissection is carried out and up, to free the entire upper half of the breast, and down to the second line of marking below. The areola attached to the skin of the lower half of the breast, is sectioned at the top, thereby producing a medial and a lateral flap, composed of areolar tissue. This will be used in the reconstruction of the areola for the new breast. These flaps are carried down to the area of the second parallel line, of the skin on the lower half of the breast. Bleeders are clamped and tied, with three 0 chromic or fine silk, or fine cotton.

A section of breast tissue, composed of gland and fat, is sectioned from the breast. Much depends upon the size of the breast one wishes to retain, as to the amount that will be left. This section, may be in the form of a triangular section, of various degrees, up to a full half of the breast. Bleeders are clamped and tied.

A wet lap pad, is now placed over the lower half of the breast, and pulled down. The section of breast is made only to the central core of the original nipple area. In this way, all the glands and circulation, to this part of the breast, are left intact.

The cut margins of the breast tissue are then sutured together, with number one chromic sutures, beginning towards the center, placing about three sutures, continuing the sutures, as the surface of the breast is approached. Several sutures are then placed, fixing the breast in the proper height on the chest, by placing the sutures in the pectoral fascia.

The skin is then permitted to drop over the newly reconstructed gland tissue. It is fitted to the new breast, and sutured with interrupted three 0 silk sutures, in a vertical direction.

The two areolar flaps attached to the lower half of the breast and skin, are now sutured in a circular manner, to each other. The lower skin margin of the upper half, and the skin

Fig. 9. (1) Shows skin closure over the old breast after formation of a glandular cone. (2) Sutures inserted but not tied in the lower half of the breast.

Fig. 10. (1) Original areola in its new location as predetermined at beginning of the operation. (2) Areolar flaps from original areola, and now attached to the sectioned part of the breast and sutured in the form of an areola. (3) Part of the original areola which was left attached to the original skin and which could have been used to make the flaps more serviceable. (4) Suture line of lower section of the breast. (5) Suture line closure of the upper part of the breast.

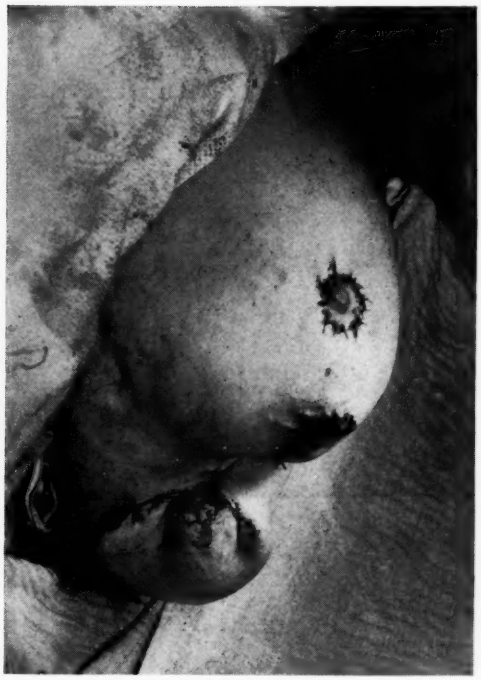

Fig. 11. Shows a view from below. The upper breast has been completed and the remainder of the tissue completely enclosed in skin tombe used for the new breast.

margin of the lower half, are now sutured to each other.

The location of the new areola of the first breast is now reviewed. An oval incision, with the long axis in a transverse diameter, and the size equal to less than the diameter of the first original incision, about the original nipple is made, and the section of tissue removed. If the gland tissue was sutured in the proper position, the original areola and nipple will spontaneously protrude into this new opening. If it does not, a slight readjustment of gland tissue, by placing a tuck here and there, will produce the desired result. The four silk fixation sutures first inserted, are now removed. The areola is sutured to the skin margins with four 0 silk interrupted sutures.

This completes the first stage. The dressings are important. Two small penrose drains are inserted, one in each angle. Vaseline gauze strip is placed over the suture lines, then a gauze pack must be placed between the upper, and lower half of the breast, with a reasonable amount of pressure, to produce a line of separation. A cup or brassiere to fit over the upper half is used, or an elastic bandage may be used to fix the dressings in place.

### SECOND STAGE

The second stage may be done three weeks later. At this time, the upper incision is made along the transverse suture line between the two breasts, and separation extended to the chest wall. Bleeders are clamped and tied. The lower incision is made in the original inframammary line, but leaving a pedicle medially and laterally, of sufficient width, to support the length of the tube formed.

The skin about the lower half of the breast is separated from the enclosed gland, and fat, for a small distance, and these skin margins are sutured together, thereby forming a closed tubed pedicle flap. The skin of the lower part of the upper breast, is now brought under the tubed pedicle, and sutured to the skin of the chest wall. Dressings are applied with care being taken to avoid any pressure upon the flap attachments.

## OPERATION—SECOND STAGE

Fig. 1. Appearance of breast before second stage surgery. (1) Areola of first breast. (2) Region of flaps of original areola and which will be used for new areola. These flaps, because of their disproportion, have already sloughed. (3) Healed vertical incision. (4) Healed transverse incision. (5) Region of remnants of old areola, still present.

Fig. 2. Shows incision in the region of the first transverse scar between the two sections of the breast.

Fig. 3. (1) Lower half of breast elevated and incision in the submammary line of the original breast. (2) Attached medial end of pedicle. (3) Attached lateral end of pedicle. (4) Lower half of the breast or the segment which will go into the formation of the new breast.

Fig. 5. (1) Shows new segment of breast completely separated from chest wall. (2) Shows skin from the inferior portion of the now newly formed right breast, being pulled under the pedicle breast to be attached to the skin of the chest wall (3).

Fig. 4. (1) Upper incision and separation of the lower breast from the upper breast. (2) Lower incision showing separation of the lower half of the breast from the chest wall. (3) Breast to be transferred. (4) Medial pedicle. (5) Lateral pedicle.

Fig. 6. (1) Shows skin of newly adjusted breast being sutured to the skin of the chest wall at the inframammary incision (2). (3) The new section of breast tissue being held away from the chest wall.

Fig. 7. (1) Shows the skin surfaces completely sutured. (2) Shows the formation of a tubed pedicle.

THIRD STAGE

The third stage is delayed for four to six weeks. Tests may be made, to determine the condition of the circulation to the tube. The tube may also be conditioned, after the first four weeks, by occluding the circulation to the lateral flap, at various intervals, for various periods of time. The length of the tube is then measured, and tested to determine the approximate location of the transferred end. A trap door is made at this area. The lateral end of the pedicle is amputated and sutured into the trap door. The donor area is closed. Dressings applied.

FOURTH STAGE

At least six weeks are permitted to pass, before this stage is done. This stage requires more conditioning of the circulation, and is the most critical and dangerous of all the stages. The same procedure is carried through, as in stage three. The length of the pedicle is measured again, a trap door is again made, except that as much of the pedicle as possible is attached to as much of the chest wall as possible.

FIFTH STAGE

Four weeks later, the remainder of the pedicle is opened, and sutured to the chest wall.

SIXTH STAGE

Rearrangement of the tissues of the new breast, to give the form of a breast. Removing tissue from the original breast, if it is too large, and transferring it to the new breast, or discarding it.

## OPERATION—THIRD STAGE

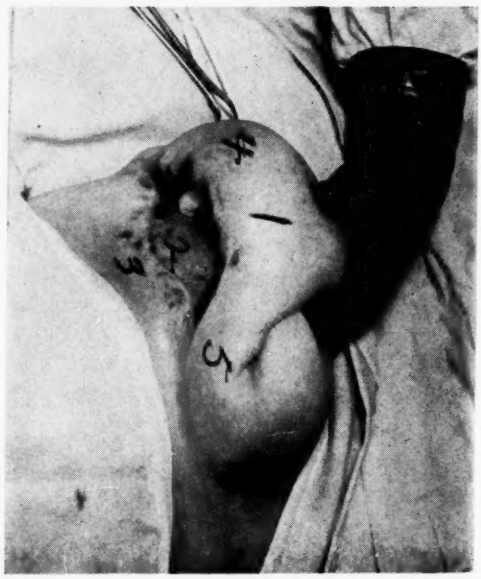


Fig. 1. (1) Tubed pedicle separated from the chest wall. (2) Inferior pole of newly constructed breast sutured to chest wall (3). (4) Lateral attachment of pedicle. (5) Medial attachment of pedicle.

Fig. 2. (1) Shows tube pedicle separated from lateral attachment of chest wall. (2) Shows the area from which pedicle was amputated. (3) What was the lateral end of the pedicle being held in the hand and will now become the medial side of the newly formed breast.

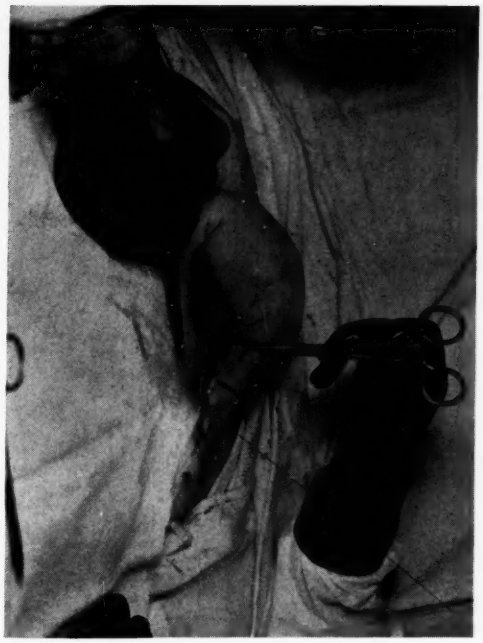

Fig. 4. (1) Shows open end of tubed pedicle being sutured to the prepared area on the left side.

Fig. 3. (1) Shows medial end of the original tube pedicle. (2) Shows the newly formed trap door on the left side of the chest. (3) Shows old attachment of the tube pedicle. (4) Detached free end of tube pedicle twisted to be inserted into newly created bed.

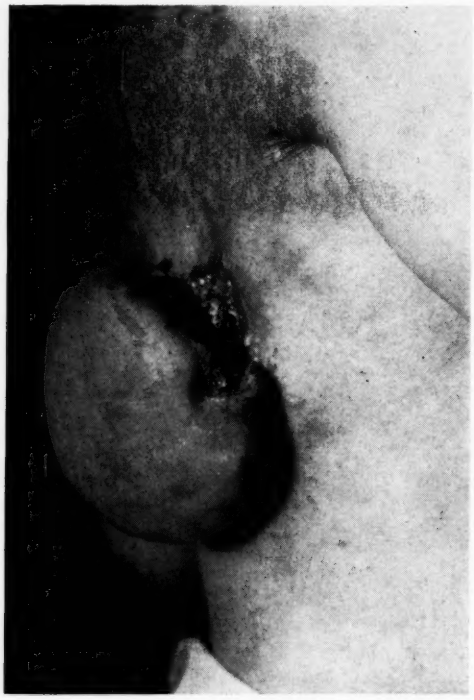

Fig. 5. Shows the tubed pedicle sutured to left chest wall.

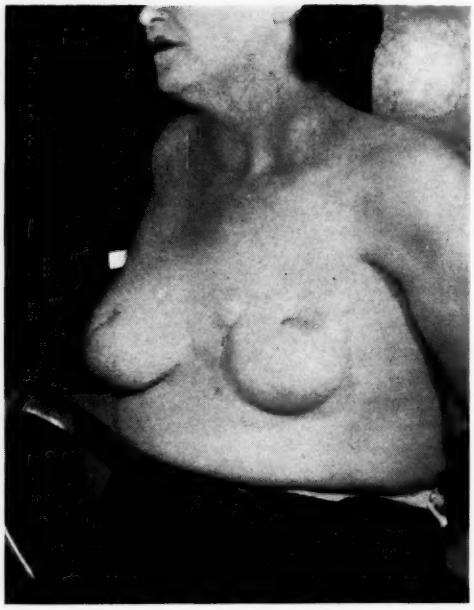

Fig. 7. Final result.

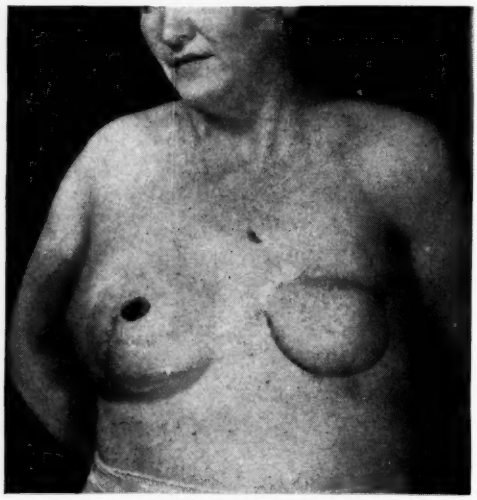

Fig. 6. Shows a comparison of the two breasts before the readjustment procedure.

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# Case Report

## Vesicovaginal Fistula of Tuberculous Origin*

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AND L. H. RODRIGUEZ DIAZ, M.D.
CARACAS, VENEZUELA

THIS report refers to the study and treatment of an interesting case of urinary tuberculosis in a girl, aged 14, who was admitted to the urological department of the Vargas hospital complaining of urinary incontinence. Examination revealed the presence of a large vesicovaginal fistula, and the findings in the case have led us to consider the possible tubercular origin of this fistula. Cases of vesicovaginal fistula of proved tubercular origin are rare, and medical literature does not record many similar instances.

The presence of a vesicovaginal fistula in a virgin, without any operative history preceding it, could not fail to arouse our deepest scientific interest. A congenital origin due to embryological developmental anomalies could be discarded, since such malformations would not fit into the picture of the present case, and the best hypothesis to explain the excretion of urine *per vaginam* through the intact hymen would be the abnormal implantation of the ureter at some level in the vagina. But this hypothesis was at once eliminated by the conducted endoscopic examination which demonstrated the presence of a vesicovaginal passage.

Since this fistula was not of obstetric or operative origin, nor was it the result of the destructive action of physicotherapeutic agents such as diathermy, electrocoagulation or radium, and since there was no evidence of vesical or genital malignancy (and no apparent possibility of a vesical calculus or a foreign body) we had to conclude that the abnormal genito-urinary passage must be the result of an inflammatory process which had partially destroyed the vesicovaginal wall.

Now, the complete clinical study of this case together with the operative and anatomopathologic findings, plus the history of a chronic urinary infection with hematuric cystitis, which determined a tubercular pyonephrosis of the left kidney with total loss of its renal function, was the only means left to determine the direct relation between the patient's proved urinary tuberculosis and the present vesicovaginal fistula.

Lacking any other satisfactory hypothesis and adhering to a logical pathological interpretation of the phenomena observed, we believe that we are justified in assuming the etiological relationship of the morbid processes presented in this case, and in considering the vesicovaginal fistula as the result of vesical tubercular lesions.

Tubercular lesions of the vesical wall may lead to its perforation. Though exceptional, it is an anatomopathologic possibility. Few well-proved cases have been recorded.

Anatomopathologic studies show that tubercular ulcerative lesions are usually shallow and do not penetrate deeply; as a rule, a fibrosclerosing periulcerative infiltrative tissue reaction acts as a protective process and prevents perforation. However, both extra and intraperitoneal perforations have been reported, the latter especially serious, for they precipitate the picture of an acute abdominal emergency, while the former give rise to vesicovaginal or vesicorectal fistulous lesions.

In 1933 Mertz carried out an important revision of the problem. Shurer in 1929 published his observations of an intraperitoneal perforation. Alton in 1931 mentioned another case. Moroney in 1943 and Scholefield in 1946 enriched the bibliography regarding this problem.

Now, returning to our own case, x-ray study revealed complete functional integrity of the right kidney but also showed a discrete distention of its ureter. Cystoscopy showed that this ureter emptied very close to, almost on the

* From the Urological Service of the Vargas hospital, Caracas, Venezuela.

border of, the fistula. These facts made one none too optimistic regarding the right kidney's future.

We were faced with the complex problem of curing the vesicovaginal fistula and at the same time preserving the integrity of the only kidney remaining after the elimination of the pyonephrotic kidney.

The possibility of closing the fistula surgically was at once discarded on account of its etiology, magnitude and extensive bladder lesions, all factors which insured certain failure beforehand for any conservative plastic operation. We therefore decided that the only possible solution of this serious therapeutic problem lay in the transplantation of the ureter into the colon, which we executed successfully following Coffey's No. 1 technic.

The clinical history of the above described case is as follows: Vargas hospital records—history No. *N 13514. M. C., aged 14,* school pupil born in Tocuyo, State of Lara. She was admitted to Surgical Service No. 1 hospital, ward No. 20, Feb. 25, 1947, on account of urinary incontinence. Her family history showed that a sister 15, and a brother 12, both died from pulmonary tuberculosis. The patient had the usual diseases of infancy, and when eight years old she had attacks of hematuria on several occasions, accompanied by urinary symptoms such as pain, urgency and frequency, while the urine was observed to be turbid in the intervals between the attacks. Simultaneously there was definite loss of weight and the patient started to pass urine involuntarily. She denied having had sexual intercourse or having submitted to any surgical operation.

Clinical examination showed a short, thin, pale, undernourished girl of sickly appearance. The blood pressure was 100-60 mm., pulse 100. The conjunctivae were pale and subicteric, and her teeth showed multiple caries. Cervical polyadenitis and chronic tonsillitis were evident. The lungs were clinically negative and the heart's rhythm and tone were normal. The abdomen was negative. The left lumbar region was tender to palpation, and an enlarged kidney could be definitely made out. The patient had not started to menstruate.

Urogenital examination revealed an intact hymen through which urine leaked out continuously. By introducing the little finger into the vagina, an opening 1½ cm. in diameter could be distinctly palpated on the anterior vaginal wall; it was equally easy to feel through the opening a sound previously introduced in the bladder through the urethra. The balance of the examination only demonstrated the presence of inguinal polyadenitis. Pulmonary radioscopy showed normal lungs.

Cystoscopy with sodium pentothal anesthesia was carried out. Previously a No. 24 Foley sound with a 30 cc. distensible bulb had been placed in the vagina, which permitted sufficient obturation of the vesicovaginal defect to permit the performance of the cystoscopy. Viewed from the interior of the bladder, the orifice of the fistula appeared double, divided in the middle by a mucous membrane bridge and surrounded as well as the entire organ by a mucosa definitely congested. Four minutes after injecting intravenously 5 cc. of a 1 percent solution of indigo-carmine, well tinted ejaculations of urine were observed issuing from a ureteral orifice situated almost on the very edge of the fistula. We failed in our efforts to catheterize this ureter, but no other ejaculations of bluish fluid were observed elsewhere within the bladder.

On introducing the cystoscope into the vagina, the vaginal folds appeared normal and the double fistulous orifice mentioned above was plainly seen. Excretion urography x-ray plates showed a normal right kidney and ureter both in function and appearance, and a functionless and definitely enlarged left kidney.

*Complementary Laboratory Investigations:* March 1, 1947. Urine: very cloudy, yellow, characteristic odor, with a heavy deposit, alkaline reaction, contains traces of albumen. Glucose, acetone biliary pigments and hemoglobin are absent. The sediment consisted of ammonio-phosphates of magnesia and alkaline earths. Pavement and round cells, leukocytes, pus cells and bacteria were present. The feces contained no parasites.

Feb. 27, 1947. Hematology—3.300.000 reds, hemoglobin 7.13 Gm., or 48 percent. Globular value 0.72 Leukocytes 18,750

Hemogram: eosinophils 1, rod-shaped 2, segmented 81. Lymphocytes 11, monocytes 5, bleeding time two minutes, coagulation time

six minutes. Globular sedimentation time: 1st hour 95, 2nd hour 114, index 76. Wassermann and Kahn reactions negative. Blood urea 0.18 per 1000. Blood glucose 1.30 per 1000.

On June 16, 1947, with gas anesthesia, we did an exploratory lombotomy and found an extensive pyonephrosis with perinephritis and periureteritis. We performed subcapsular nephrectomy, which was tedious and laborious, but the patient made a very satisfactory recovery. The pathologist's report states "Macroscopically, kidney weighs 120 Gm., measures 10 cm. in its longitudinal axis, 5½ in the transverse and 4½ in the anteroposterior: surface appears lobulated. On hemisection we find the pelvis very much dilated, holding in its interior a large amount of a reddish yellowish liquid. The pelvic wall appears smooth in spots, whereas it is distinctly rough in others. The ureter is widely dilated and surrounded by connective tissue. The medular and cortical zones have practically disappeared, with only occasional layers of a thickness of 4 mm. remaining. Microscopically, many tubercular follicles are observed, together with a widespread purulent inflammatory process."

Diagnosis: renal tuberculosis and chronic pyelonephritis.

On June 25, 1947, the search for Koch's bacilli in the urine was negative. July 8, the inoculation of guinea-pig with urine was negative. July 14, the red blood count was 3,560,000 cells, hemoglobin 9.52 Gm., (62 percent) and the globular value was 0.88.

On Aug. 12, 1947, with gas anesthesia, we performed right ureterocolostomy according to Coffey's No. 1 technic. The immediate postoperative course was satisfactory, but 13 days after the operation the patient presented intestinal hemorrhage accompanied by generalized edema and loss of consciousness, which compelled us to employ the most energetic measures at our command, such as blood transfusions, serum injections, cardiac tonics, coagulants, oxygen, etc.

New laboratory investigations on Aug. 29 yielded the following information: red blood count 3,200,000, hemoglobin 8.7 Gm. (57 percent), globular value 0.89. Leukocytes 8,100, eosinophils, four, rod-shaped six, segmented 66, lymphocytes 18, monocytes six. Blood urea 1.33 per 1000. Three days later the hemorrhage ceased and the patient recuperated from her attack of acidosis and renal insufficiency, and laboratory investigations on Sept. 2, showed blood urea 0.28 per 1000, red cells 2,000,000, hemoglobin 3.60 or 27 percent, globular value 0.67, leukocytes 14,400, eosinophils seven, rod-shaped four, segmented 62, lymphocytes 23, monocytes four and some abnormal red cells: macrocytosis with hypochromia.

After the present report was written, we were informed that our patient's mother has been admitted to our hospital on account of severe hemopthisis, and that the radiologic diagnosis was bilateral tubercular lesions in evolution.

The condition of our patient is at present satisfactory.


## SUMMARY

A case of urinary tuberculosis in a girl 14 years old, in which a left-sided pyonephrosis and an incurable vesicovaginal fistula resulted, is here described. The treatment employed consisted in a left nephrectomy and a right ureterocolostomy.

## RIASSUNTO

Descrivono e discutono un caso di tubercolosi urinaria in una ragazza di 14 anni. Avendo la malattia condotto all'insorgenza di una pionefrosi e ad una fistola vescico-vaginale, gli AA. hanno fatto recorso ad una nefrectomia e ad uní ureterocolostomia.

## SOMMAIRE

Un cas de tuberculose urinaire chez une fille de 14 ans présentant une pyonéphrose du côté gauche et une fistule vésicovaginale, est décrit avec commentaires. On enleva le rein gauche et on fit une unétérocolostomie du côté droit.


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# Postoperative Use of Heparin in Prophylaxis Against Thrombosis

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IN RECENT years, significant progress has been made in the treatment of postoperative thrombosis. The sudden appearance of an embolism without preceding signs of thrombosis is still, however, a great surgical danger. Therefore, complete control of thrombosis will be possible only when an effective prophylactic is available. Heparin has played a large part in obtaining improved results in the treatment of frank thrombosis; it is of the greatest importance that the possibilities of heparin as a prophylactic should be realized.

In prophylactic heparin treatment, the amount of heparin administered and the intervals between injections is of the greatest importance both from the point of view of results and from that of economic convenience. From the clinical-therapeutic point of view, there is no definite opinion as to dosage. The reason for this, at least in part, is that the theory of heparin activity is still not fully understood. In clinical practice it has been the custom to give relatively large daily doses, which seem fairly safe; but how nearly these doses approach the optimum remains uncertain.

The effective use of heparin demands a sufficiently large quantity. On the other hand, an overdose means unnecessary expense in a treatment that is already costly, and at the same time involves an increased danger of hemorrhage, at least in the case of postoperative prophylaxis. Furthermore, very frequent injections cause the patient inconvenience and place heavy demands on the hospital staff. These facts seem to indicate that a decrease in the dosage is desirable, but security must be placed before everything else, and should always be borne in mind in determining the dosage routine.

In Sweden, reports on surgical patients prophylactically treated have been published by Crafoord (1937) and Strombeck (1942) and on gynecological-obstetrical patients by Wetterdal (1941) and Leissner (1942). For the most part, the table constructed by Crafoord and Jorpes has been followed. This table prescribes a dosage of about 250 mg. every 24 hours, divided into three daily doses of 50 mg. and one night dose of 100 mg. The duration of the treatment varies between five and 10 days.

In the aforementioned series, no case was reported in which thrombosis occurred during treatment. After treatment, thrombosis occurred in three cases. The series were, however, from a statistical point of view, rather small. Crafoord's covered 325 cases, Wetterdal's 127, Leissner's 117, and Strömbeck's 40. Judging from these series, this dosage would seem to provide a safe protection against thrombosis during treatment. The question remains whether it was the relatively large quantities in themselves that prevented thrombosis. In settling this question, it is of value to note how coagulation time is affected during a 24-hour period by the quantities and the total dosage mentioned.

From Crafoord's, Hedenius' and Wilander's studies of the effect of heparin on coagulation time in human subjects, it is known that a dose of 50 mg. prolongs coagulation time above the normal for about three hours. Prolongation after a dose of 100 mg. of heparin lasts about four hours. If, from these results, we construct a 24-hour curve based on the most frequently used doses in postoperative prophylaxis to date (50 mg. three times daily, together with a nightly dose of 100 mg.), we find that, even with this relatively large total daily dose of 250 mg., there are intervals (totaling 11 to 12 hours during a 24-hour period) when the coagulation time is almost down to normal, and when the treatment, from the point of view of prolonging coagulation time as measured by relatively

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inaccurate instruments and methods, is ineffective.

Furthermore, although these quantities and doses seem effective against thrombosis during treatment, it is obvious that they cannot provide protection for more than a short period *after* treatment.

This provokes another question: To what extent does this regimen provide unnecessarily high doses, and how much is it possible to increase the intervals in the observable activity of heparin. Furthermore, one wonders whether the heparin may not have a prophylactic effect against thrombosis that does not show itself in our relatively inaccurate measurement of coagulation, yet plays an important role during certain short periods.

My opinion is that, at least from the prophylactic point of view, there is no need for such a prolongation of coagulation time as is produced by the relatively large daily quantity of heparin just mentioned, and also that, in any case, this overdosing and overprolongation of coagulation time does not necessarily contain an additional guarantee against the development of thrombosis. In my opinion, since the normal level of heparin is low, the addition of even a small dose should have a favorable effect and possibly, in most cases, produce as good results as would the larger quantity.

Partly to support this theory and partly to make a contribution to discovery of the optimum dose, I have studied the prophylactic activity of a daily dosage of 100 mg. of heparin. This was given in two injections, each of 1 millilitre containing 50 mg., morning and evening. The treatment was begun on the day after operation. It was continued until the patient got up, or at most for 10 days. The series included patients with operative areas susceptible to thrombotic-embolic complications; areas in the fields of abdominal, urnogenital, renal and prostatic surgery. Since thrombosis and embolism are rare in young persons, the treatment was confined to patients over 30 years of age. The normal five percent vitrum-heparin preparation was used.

The table contains data on all the prophylactically treated patients during a three-year period and all patients treated non-prophylactically during the same three years. These two groups are nearly identical in number; the first group includes 1,266 patients and the second group 1,254.

The difference in the frequency of thrombosis and embolism is considerable. Of the

Abdominal Operations During Three Years*

| Organs | No prophylaxis | | | Prophylaxis with heparin 50 mg.×2 | | |
|---|---|---|---|---|---|---|
| | Cases | Cases of thrombo-embolism | Dead of pulmonary embolism | Cases | Cases of thrombo-embolism | Dead by pulmonary embolism |
| Ventrical and duodenal | 111 | 3 | 1 | 186 | 0 | 0 |
| Hernia | 178 | 3 | 2 | 263 | 1 | 0 |
| Appendicitis | 623 | 7 | 0 | 318 | 1 | 1 |
| Colon-rectum | 28 | 3 | 2 | 25 | 0 | 0 |
| Gallbladder | 102 | 5 | 2 | 255 | 1 | 1 |
| Ileum-jejunum | 31 | 0 | 0 | 15 | 0 | 0 |
| Pancreas | 3 | 1 | 1 | 1 | 0 | 0 |
| Urinary system | 66 | 1 | 1 | 74 | 0 | 0 |
| Genital system | 112 | 2 | 1 | 129 | 0 | 0 |
| Total | 1254 | 25 | 10 | 1266 | 3 | 2 |

*The investigation is from St. Gorans Sjukhus, Stockholm.

treated patients, only three had thrombo-embolism during treatment. Of these, two died of pulmonary embolism. After the treatment (from six to 18 days) symptoms of thrombo-embolism occurred in eight cases. In the 1,254 cases in which heparin was not used, thrombo-embolism occurred in 25 with 10 of the patients dying of pulmonary embolism.

It is proved that the heparin treatment used provides an important protection against thrombo-embolic complications. The protection is not, however, complete.

So far as the risk of postoperative hemorrhage is concerned, prophylactic treatment with the larger heparin doses of 250 mg. increases this risk so much that such treatment is contraindicated. With the smaller dose (100 mg. per 24 hours) the risk of hemorrhage is reduced to a minimum.

SUMMARY

A postoperative prophylactic treatment with heparin in accordance with the aforementioned system (100 mg. per 24 hours, comprised of a morning and evening dose of 50 mg. each, commencing on the day after the operation and continuing until the patient leaves his bed, or at the most for 10 days) gives an important protection against the appearance of thrombo-embolic complications during treatment.

The risk of hemorrhage due to administration of this quantity of heparin has proved to be extremely small or even nonexistent.

SUMARIO

El uso profilactico de la heparina durante el tratamiento post-operatorio por el metodo que se ha descrito en este articulo (100 mgms de heparina en 24 horas en dosis de 50 mgms manana y noche, comenzando desde el dia despues de la operacion por no mas de diez dias) da gran proteccion contra las complicaciones trombo-embolicas durante el tratamiento. El peligro de una hemorragia por la heparina ha sido en nuestra experiencia tan pequena que se le puede considerar como no-existente.

SOMMAIRE

Un traitement prophylactique postopératoire avec l'héparine selon le système précédemment étudíe "100 mg. pour 24 heures, 50 mg. le matin, 50 mg. le soir," débutant le jour avant l'operation et continuant jusqu à ce que le malade qui est au lit se lêve. Ce traitement fournit une protection importante contre l'apparition de complications thrombo-emboliques durant le traitement.

Le risque d'hémorragie duè a l'administration de cette quantité d'hérapine, est minime, ou plutôt n'existe pas.

# Blockage of Splanchnic Nerves for Relief of Pain and Splanchnic Dystrophy*

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CERTAIN observations on patients with visceral pain of varying origin (colic, cancer, peptic ulcer) dramatically relieved by blockage of the splanchnic nerves were reported in a paper, "Algias Esplánenicas," read before the Mexican Academy of Surgery. Along the same lines, new observations were made on the trophic effect upon the viscera produced by blockage of these nerves, suggesting the possibility of functional and anatomical restoration by this method of the viscera affected. First observations and later findings, together with discussions and interchange of ideas with some South American surgeons, resulted in the publication of the book "Mortal Pains."

The original conception has been broadened now by new experiences. The work, although personal, has been sustained, approved and has stimulated other workers and investigators in South America. It is hoped that new fields for clinical and physiologic research will be opened thereby. This paper is a brief summary of the fundamental observations. It does not pretend to be a formulation of doctrine; it simply presents some elements for further study and research.

## GENERAL CONSIDERATIONS

One of the best methods of studying organic function is the suppression of the nerve supply to an organ. This method has exposed interesting fields of research in abdominal pain. The effect of blockage of the splanchnic nerves by novocaine and alcohol has an effect lasting sometimes more than two months. If repeated, the effect can be made to last indefinitely. It has been demonstrated on several occasions that the splanchnic nerves carry pain impulses from the viscera of the thoracoabdominal regions and that their blockage stops the pain immediately.

On clinical grounds it was suspected that the sympathetic nerves have a dystrophic effect in certain pathologic conditions, such as peptic or trophic ulcers—diseases that can be treated by splanchnic nerve blockage. This observation was supported by the work of Leriche and Dogliotti, who have been able to obtain temporary relief by this method in certain cases of diabetes mellitus.

These facts, together with the well-known trophic effect of the sympathetic nervous system in the presence of varicose ulcers and endoarteritis of the lower limbs, so often relieved or cured after sympathectomy reinforced the idea that splanchnic nerve blockage can produce a similar trophic effect, through vasculomotor paralytic dilatation, upon the pancreas, the kidneys, the bowel or the heart.

Other effects of blockage are the relaxation of spasm in the biliary, urinary and digestive tracts, as well as in the coronary vessels. The treatment also benefits some atonic conditions in the gallbladder and large intestine.

In practice one often encounters severe abdominal pain referred to the epigastrium or to the upper part of the abdomen, with no visceral lesion detectable. Such a condition is sometimes called solaritis. In one such case, which provided one of my earliest experiences with the effectiveness of splanchnic nerve blockage, immediate relief of a long standing painful condition was obtained. Alcohol was employed. The date of treatment was Feb. 8, 1941, and by Oct. 10, 1944, at which time the case was reported to the Mexican Academy of Surgery, the pain was still absent and the patient apparently cured.[1] Since then our records have been enriched by similar successes.

## PEPTIC ULCER

For this study, only those patients with a clinical and roentgen diagnosis of uncomplicated peptic ulcer were chosen and treated. After blockage of the sympathetic nerves, the pain and the burning sensation disappeared.

* Presented at the Sixth International Assembly, International College of Surgeons, Rome, May 16-24, 1948.

Very often the relief lasted so long as to be considered a permanent cure. One of the earliest cases was that of a factory worker treated on Oct. 11, 1942 and cured up to the present time. This case was reported at the Mexican Academy of Surgery.

More recently, 20 patients have been treated and controlled clinically and roentgenologically. Because of the peculiar periodicity of pain in this disease it is necessary to continue observations for a longer period and on a greater number of patients before jumping to conclusions. However, up to now, results have been constantly favorable so far as the control of pain is concerned.

### BILIARY COLICS

This syndrome is of frequent occurrence and sometimes requires a blockage as a purely symptomatic treatment for temporary relief. In one case a unilateral blockage was performed on the right splanchnic nerve. Failure followed this treatment. Since then it has been considered necessary to treat both sides. This case also tends to confirm the idea of the functional unity of the whole sympathetic system in the abdominal cavity.

### PANCREATITIS

In early acute pancreatitis the pain is dramatic and agonizing. Sustained anesthesia of the splanchnic nerves was employed for relief. In cases of pancreatitis without great organic damage, when recovery was possible, progressive improvement was observed after several such treatments, probably due to a trophic effect upon the gland or to paralytic vasodilatations over its area. The control of pain in pancreatitis provides a sounder basis of study and observation over a longer period.

An illustrative case is that of Mrs. F. V. de Z., aged 68, alive and cured at the present time. On Sept. 25, 1946, she had a sudden, intense and dramatic pain in the upper part of the abdomen. Morphia and other sedatives were useless; after a careful clinical examination, a diagnosis of acute pancreatitis was made and the splanchnic nerves were blocked with novocaine-alcohol. The pain was relieved almost immediately. After the depressing effects of narcotics (previously administered) had receded the patient recovered quickly. In a few days, with the help of a blood transfusion and an adequate diet, she was normal and apparently cured. Four months later she suffered a second attack. Similar treatment was given, with the same spectacular results, but with less general bad effect, since the treatment was applied earlier and without preliminary administration of narcotics. Then followed a period of complete relief, and five months later a new crisis occurred. A new blockage was performed and the result is an apparent cure up to the time of writing.

From this and other cases (13 in all) it is concluded that in addition to the control of pain, blockage of the splanchnic nerves produces a trophic change in the pancreas, probably by means of a paralytic vasodilatation.

### DIABETES MELLITUS

Patients suffering from diabetes of pancreatic origin were also treated by novocaine-alcohol blockage with prolonged observation when a series of such treatments were given.

In these cases the favorable results are probably due to a trophic change produced through paralytic vasodilatation, with effects similar to those observed in ulcers of the lower limbs after periarterial sympathectomy. The case of Mr. J. M., aged 40, could be given as an example. This patient presented a complete clinical picture of diabetes. The blood sugar was 200 mg. glycosuria with 26 gr. per 1000 and polyuria of 3000 cc. On Feb. 28, 1946, blockage with alcohol was performed. The glycosuria disappeared; clinical recovery was obtained, and the blood sugar level became normal. Periodic checkups were made on the blood and urine. In July 1947, after excess in diet and ingestion of alcohol, diabetic symptoms and signs reappeared. A new treatment was given and control of the disease has been maintained up to now.

In summary, spectacular results were obtained by blockage of the splanchnic nerves in certain cases of hemorrhagic-pancreatitis and diabetes. The fact that the treatment can be repeated without danger is important. One patient with acute pancreatitis, treated a year and a half ago, represents the most nearly permanent cure. Cure of pancreatitis is possible of course in cases with discrete hemorrhagic lesions; if stones are impacted in

Wirsung's duct the situation is less hopeful. Thirteen cases of pancreatitis have been treated successfully by this method.

### RENAL COLIC

Several patients with pain of renal origin were treated by alcoholization of the sympathetic nerves. J.C.G., a male patient with a horseshoe kidney, who had been suffering for four years with colic, had been treated without success in several North American clinics. Blockage was performed and the improvement was so great that the patient was soon able to reassume his normal activities. In the presence of calculi, this treatment is mainly symptomatic and preoperative.

### ABDOMINAL CANCER

In August 1944, a patient with inoperable visceral cancer was treated by blockage of the splanchnic nerves. Since then, excellent and sometimes unexpected results have been obtained in many cases. Blockage is indicated only when the neoplasm is confined to the viscera affected. It is unsuccessful when there is invasion of adjacent structures.

In several cases it has been possible to follow the progressive but painless advance of the disease until death, which usually occurs from obstructions of the digestive tract by the tumor mass. It is interesting to learn that Prof. Felix Mandl, of Vienna, has also been working along these lines.

### HYPERTENSION

The book "Mortal Pains" carries mention of the work done by the Portuguese surgeon Sousa Pereira, who has tried novocainization of the splanchnic nerves as a preoperative test, to establish the indication for resection of the splanchnic nerves in the treatment of high blood pressure.

This method, although logical, is not so successful as it was, except at the beginning, mainly because the effect of novocainization lasts only four hours and the novocaine in itself is hypotensive. Alcoholization, on the other hand, remains effective sometimes for over two months. It is very useful not only as a preoperative test but as a curative procedure. It is indicated: (a) during the actual crisis of hypertension when a quick effect is desired; (b) to diminish the risk of operation; and (c) as a treatment of hypertension by means of a series of blockages at intervals of at least two months.

It is important to note that in the present series, the desired depressive effect on the blood pressure has been obtained regardless of the level at which the blockage was done. The sympathetic system is a functional unit that within certain levels (paravertebral chains) acts as a whole.

Blockage must be done on both sides, because failure usually follows unilateral treatment. In cases of hypertension, blockage at the level of the lowest dorsal vertebral is the treatment of choice, perhaps because of a more direct effect over the renal areas.

The case of R. V. de M., a woman aged 70, is illustrative because of the association of hypertension and diabetes. This patient showed an excellent response of both diseases after the treatment. For a long time she had been suffering from hypertension, with frequent hemorrhages. The systolic blood pressure was 290 max. and 220 min. but often these figures went up in a very alarming way. In May 1947, a bilateral blockage of the sympathetic nerves was performed at the end of the first lumbar vertebra. The blood pressure was lowered to 130 max. and 90 min. Glycosuria disappeared and blood pressure has remained unchanged up to the present.

A marked asthenia, such as that observed in cases of Addison's disease, followed the treatment. It lasted about two weeks, after which everything became normal. At present, the blood pressure is within normal limits and the diabetes under control.

Another interesting case is that of F. R., a young man who suffered from malignant hypertension. Doctors at the Seguro Social had predicted his death. After treatment by this method he obtained relief for periods of two months at a time, sometimes prolonged by serial treatments. The blood pressure is quite satisfactory, and the frequent retinal hemorrhages from which he had been suffering have not reappeared. Six blockage treatments were performed in a period of 18 months. In another case, in which there was associated diabetes, a profound asthenia followed the hypertension produced by the treatment.

Treatments were applied at the level of the 12th dorsal vertebra, in the hope of a possible direct effect over the renal area.

Prof. Felix Mandl, a pioneer in this field of work, reports a favorable response from 42 percent of the patients treated by this method. The experience in this clinic is less extensive, but the statistical results are slightly higher, owing perhaps to the different technic used. We have employed larger doses than Professor Mandl, and the treatments have been repeated more often. However further observations must be made before a final statement can be released as to the percentage of cures and the final results in cases of hypertension.

### HYDRONEPHROSIS

Blockage of the splanchnic nerves has been recommended in the treatment of this condition. Quick and sustained improvement and some cures have been obtained in patients treated by novocaine-alcoholization. J. J. C., a man aged 25, with a long history of urinary disturbances and low back pain with associated muscular spasms, had been submitted to innumerable treatments at home and abroad, mainly in the United States, this was seen at this clinic April 22, 1946. After an excretory urogram had been made his condition was diagnosed as hydronephrosis. On the 26th of the same month, alcohol blockage was performed. Soon after the treatment of relief, the symptoms were observed. Up to now the patient is free from subjective disturbances. Roentgenologic improvement has been reported.

### DYSMENORRHEA

A fair number of observations have been made, with results similar to those obtained by the Cotte operation. The probable trophic effect of the method should be emphasized here.

### CHRONIC CONSTIPATION AND DIGESTIVE ATONY

We have some observations of selected cases of these diseases with good results. In one case there was a history of lifelong constipation with digestive atony and malnutrition. Blockage improved the digestive function and relieved the constipation, and the patient's general condition now is very good.

### TECHNICAL CONSIDERATIONS

The injection should be performed with the patient in the prone position. When lasting effects are desired, inject 10 cc. of alcohol in each side.

The novocaine-alcohol infiltration is not free from danger, and the patient must be hospitalized to control any immediate complications after treatment. One very unpleasant accident is infiltration of the posterior roots, which may cause very severe neuritis. If the patient notices paresthesia along the lower limbs during the injection, it is wise to withdraw the needles and change its direction. The injection is more difficult when the prevertebral fat tissue surrounding the splanchnic nerves is anty. Neuritis or neuralgia produced by accident should be treated by the ordinary means and by diathermy.

### COMMENT

This preliminary work has been much encouraged by comments of colleagues at home and abroad. Some of them, including Gutierrez, believe that with this method a newer and wider horizon has been opened. Dr. Alfonso Asenjo, director of the Neurosurgical Institute, Hospital del Salvador, Chile, is enthusiastic about the method. As has been stated, time and further observations are needed to establish its value. The work will be continued and further statistics compiled. Evidence at present indicates that blockage of the splanchnic nerves offers a new and efficient means to relief and possible cure.


### RIASSUNTO

Questo lavoro preliminare è stato molto incoraggiato da commenti nazionali ed internazionali. Toluni, compreso Gutierrez, ritengono che il metodo proposto dall'A. apra la strada a nuovi e più vasti orizzonti. Altri, fra i quali Alfonso Asenjo, Direttore dell'Istituto Naurochirurgico (Ospedale del Salvatore) Cile, si ne dichiarano entusiasti. Il lavoro d'indagine continua, onde fornire più larghe statistiche: ma fin d'ora, il blocco dei nervi splancnici sembra costituire un nuovo e valido mezzo palliativo, se non addirittura curativo.

SUMARIO

Este trabajo preliminar ha sido animado por los comentarios favorables de colegas tanto aqui como en el extranjero. Algunos de los colegas, incluyendo el Dr. Gutierrez, creen que este metodo ha abierto horizontes muevos y amplios. El Dr. Alfonso Asenjo, Director del Instituto de NeuroCirujia del Hospital del Salvador en Chile esta muy entusiasmado aserca de este metodo. Como ya se ha dicho solo el tiempo y mas observaciones son necesarias para establecer su valor.

Sin embargo, la evidencia al presente indica que el bloqueo de los nervios esplacnicos ofrece un metodo nuevo y eficiente para producir el alivio, y posiblemente la curacion.

SOMMAIRE

Ce travail préliminaire a été beaucoup encouragé par des commentaires de collègues du Chili et de l'étranger. Quelques uns comme le Dr. Gutirrez, sont d'avis que cette méthode nous offre un nouvel et plus large horizon. Le Dr. Alfonso Asenjo, directeur de l'Institut Neurologique à L'hospital se Salavador du Chili, est très enthousaste de cette méthode. Ainsi qu'il a été dit précédent, le temps et d'autres observations sont nécés aires pour établir définitivement sa valeur. Le travail se poursuit et d'autres statistiques seront à établir. Te semble evident à present que le blocage des nerfs splanchniques affre soulagement nouveaux et efficaces des moyens de et aussi de guérison possible.

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# Lumbosacral Flexion Arthrodesis*

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THE authors have performed approximately 300 lumbosacral fusions, with the earlier operations following the Albee or Hibbs methods. Later multiple granules or chips were used. During the past five years a wedging bone block has been inserted in the posterior space between the fifth lumbar spinous process and the sacrum. It appears that better results are being obtained by the latter method. No definite conclusions, however, can be made, since an insufficient lapse of time has occurred for determining the value of the procedure.

The operation is indicated for unstable lumbosacral spine, degenerated or protruding discs, displacement or arthritis of facets, narrowing of the intervertebral foramina, and posterior displacement of the fifth lumbar vertebra. In most of the patients it appears that flexion at the lumbosacral area tends to correct the condition. For that reason our more recent operations have utilized the insertion of a thick bone graft in the posterior lumbosacral space.

*Operative Procedure:* The patient is given a thorough scrubbing with soap and water for 10 minutes prior to making an incision which extends from the third lumbar vertebra to the midportion of the sacrum. The operation is performed with the patient in the prone position with the low back flexed on a hinged table. The incision is kept in the midline so as to avoid the muscles which bleed freely. All the ligaments and muscles are denuded from the spinous processes and lamina of the lumbosacral region as far as the lateral apophyseal articulations.

After the capsule has been removed from the posterior lumbosacral facets, the posterior lumbosacral facets are denuded of their cartilaginous surfaces using a small curet. Drill holes are made from the outer lamina through the facets to the lateral masses of the sacrum using a No. 31 drill. The direction is downward and outward and this is done with the patient maintained in the flexed position. Screws 7/8 inch to 1¼ inches in length are inserted through the drill holes of each lumbosacral facet. It will be noted that no motion is possible after a screw has been placed on each side. The flexion at the lumbosacral area is maintained.

A second incision is then made over the posterior iliac spine and using subperiosteal dissection a graft, approximately two inches in length and one inch in thickness, is removed from the thickest portion of the bone. The graft is notched at its midportion on each side so that it can be mortised into the lumbosacral space posteriorly. Before this is done, however, the spinous processes of the fifth lumbar vertebra and sacrum are slightly undercut so as to obtain a keystone-shaped recipient area. The lamina are also freshened so that the graft will lie against raw bone.

Numerous small chips can be placed deep in the lumbosacral space. These chips can be obtained from the donor site of the ilium. The notched graft must be driven into the recipient area *with force* so that it is firmly wedged in position. If properly done, the bone block cannot be moved. It is important that no more bone be removed from the spinous processes than is necessary to freshen the surfaces so that these processes will not be weakened. It is also recommended that the screws be placed through the facets prior to the insertion of the bone block since the area is more stable and since technically, it is an easier procedure. It is important, also, that a thick graft be taken which can be driven deeply against the lamina, offering a strong substantial graft. The closure is by the usual method.

No cast is applied unless it appears that a stable wedging graft has not been obtained. This occasionally happens if the sacral spinous

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process is underdeveloped. If a cast is applied, it should be a bilateral hip spica cast extending to the supracondylar region of the femora.

Sixty patients have been operated on using the wedging flexion bone block. The last 39 of these patients had screws inserted through the lumbosacral facets. It is the authors' opinion that immobilization is more firm when screws are used with a mortised bone block. It is believed that the screws maintain good fixation for a period of approximately six to eight weeks during which time union of the graft may have been accomplished. Ordinarily, the patient is kept in bed for a period of three weeks following the operation. No corset or other support is used. It is believed that arthrodesis takes place in a period of four to six months permitting normal activity. Until that time, the patient is advised to avoid any direct strain to the low back. Fusion between the fourth and fifth lumbar vertebrae is not recommended in the average case since it is our opinion that the pathology exists almost entirely in the lumbosacral area.

There has been considerable controversy regarding lumbosacral pain and its associated sciatica. Some feel that arthritis involving the ligaments and the apophyseal joints is the most common cause. Relaxation of ligaments with unstable lumbosacral joints is often suspected. In the past six to eight years the role of the degenerated and protruding intervertebral disc has had increased attention. Regardless of which of these causes is present, the position of flexion tends to correct it. If the patient has a protruding disc, flexion causes the disc to return to a more normal position. This was demonstrated by Love and Walsh in the laboratory who noted that hyperextension caused the intervertebral disc to protrude markedly backward. They also noted the return of the protruded disc back into the intervertebral space almost level with the posterior surface of the vertebral bodies during flexion. Similar observations were made by Schaetenschneider. Very frequently at the time of operation one notes the degree to which the disc protrudes backward by extending the patient on the operating table. In the case of the degenerated disc, narrowing of the interspace takes place, causing a subdislocation of the facets. Ligamentous strain results and frequently arthritis occurs in the apophyseal joints. The flexion bone block returns the facets to a more normal position and in the thinned lumbosacral intervertebral space the posterior portion of the space is widened. It is obvious that diminution of the intervertebral foramina will follow disc degeneration or displacement of the facets and pressure is relieved on the nerve roots by literally opening the foramina when the patient is brought into the flexion position.

In most of the conditions mentioned it can be understood that ligamentous strain is apt to follow the mechanical derangement. When one recognizes the abundant nerve supply to the lumbosacral ligaments, the deep seated pain can be understood. This area is the site of strain with symptoms initially referred to the low back and later followed by referred pain into the sciatic distribution. This disorder requires flexion for relief of symptoms and for that reason the patient usually stands or lies with his back flexed and frequently pulls his knees up against his chest while lying in bed. This is the reason why acute cases are treated successfully in the hyperflexed position on a Gatch bed, elevating the head and thighs so as to flatten the low back. Most of these patient are cured by conservative treatment and in our series only five percent have required surgical stabilization.

Credit should be given Breck and Basom, Bosworth, Moore, King, for their methods of fusing the low back area in flexion. Interlocking grafts of various types have been described by them. Breck and Basom stress the need for conservative treatment in flexion for an adequate period of time but state that surgery must be resorted to in a small percentage of patients. A mortised interspinous bone block is used restoring the intervertebral interspace to normal, reducing the accompanying subluxation and giving internal fixation to the routine spine fusion grafts. King obtained rigid fixation by placing screws through the lateral articulations with the lumbar lordosis partly obliterated by lowering both the head and foot ends of the table. Bosworth inserts a clothespin graft which is taken from the ilium or tibia and has the ends notched out to receive spinous processes at either end of the fusion area. Moore uses a self-locking

prop bone graft with a tibial graft notched at both ends and an opening in its midportion which fits over the fifth spinous process.

Regardless of which method is used the principle is the same. Some surgeons because of their training and experience have found a particular type of fusion more successful in their hands than other types. Many surgeons prefer an Albee or Hibbs fusion since these are more universally used and have been more popular in the past. It is entirely possible that a Hibbs or Albee fusion combined with screw fixation may be very effective. Although we have not used the latter methods, that is, with screw fixation, such a series would be very informative and valuable. However, one must be very conservative in judging his results and should not be overenthusiastic about any new procedure which attempts fusion of the lumbosacral area.

Homogenous bone can be used for grafting this area. It has been shown that homogenous bone taken from the ilium or upper tibia can be cut in long thick strips, two to three inches in length, and kept in a deep freeze and used when required. Very little reaction takes place and studies of the operated area at a later date show good union. Although the average orthopedist hesitates to use bone other than autogenous bone, the advantages of homogenous bone must be admitted since it simplifies the procedure. The author has had very little experience with these grafts but it is our opinion that this form of graft wedged into the lumbosacral space deserves real consideration. When one realizes that the bone graft in any instance acts only as a scaffold, he can see its advantages. It appears likely that in centers in which there is a bone bank more extensive use of this form of grafting will follow.

*Results:* Sixty patients have been operated on using the flexion bone graft. Twenty-one of these patients were fused without the use of internal metallic fixation and in 39 patients, a combined method with screw fixation to the facets was used. Most of these patients have been checked clinically and by x-ray films postoperatively at periodic intervals. It appears that better results are obtained with the combination of a flexion bone block and screw fixation. Three of our patients have had infections which had eventually subsided. These occurred where a single incision permits a communication between two relatively deep wounds, making the control of infection difficult. Most of our patients have been checked by straight AP and lateral x-rays but more recently we have been following the recommendation of Bosworth of taking films in flexion, extension, and lateral deviation. A determination of the success of the arthrodesis can be better determined by such films since these positions will reveal failure of attachment to the lumbar or sacral structures.

SUMMARY

Arthrodesis of the lumbosacral spine should be performed in flexion in the average chronic case with low back pain which may be due to displacement or arthritis of the facets, narrowed intervertebral foramina, relaxed lumbosacral joints, disc degeneration and protrusion, and backward displacement of the fifth lumbar vertebra. Arthrodesis in flexion tends to correct the abnormalities without requiring excision of the responsible factors. The flexion bone block utilizes the principles of successful bone grafting, that is, suitable grafting material (iliac bone), compression, and immobilization. The use of screws through the facets reinforces the immobilization obtained by a mortised bone block.

SUMMAIRE

L'arthrodèse de la colonne lombosacrée doit être exécutée en flexion dans la moyenne de cas chroniques avec douleur du bas dos qui peut être dû au déplacement ou à l'arthrite des facettes, de foramens intervertébraux reserrés, d'articulations lombosacrées relachées, de dégénération des disques avec saillie de ceux-ci, et de déplacement en arriére de la cinquième vertèbre lombaire. L'arthrodèse en flexion tend à corriger les anomalies sans demander l'excision des facteurs résponable. La greffe osseuse en flexion utilise les principes généralement admis: c'est à dire, l'emploi de matériel convenable pour la greffe (l'os iliaque), la compression, et l'immobilisation. L'emploi des vis à travers les facettes renforce l'immobilisation obtenue par une greffe osseuse mortaisée.

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## INTERNATIONAL COLLEGE OF SURGEONS
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In connection with the celebration of Hippocrates Day on October 23, the International College of Surgeons announces the award of a $100 Government Bond for the best essay on "The Meaning of Hippocrates in the Medical World of Today." Although the award is offered specifically to men of the medical profession anywhere in the world, there is no restriction as to eligibility; manuscripts submitted by non-professional writers will also be considered. Dr. Skevos Zervos, noted Greek physician and authority on the life and work of Hippocrates, will head the judges' committee. All essays submitted should be addressed to

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# Dysuria Due to Retrovesical Echinococcus Cyst

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A FARMER, aged 61, married and a father, was sent to the hospital with a diagnosis of dysuria and retention caused by prostatic hypertrophy. For nearly two years he had had pollakiuria and then difficult micturition, while a perceptible vesical globus had become outlined upon the hypogastrium. Lately micturition had become very difficult and very slow, occurring drop by drop.

*Examination:* There was an evident hypogastric globus. Vesical catheterization was difficult on account of palpable resistance against passage of the tube into the posterior urethra: 100 cc. of retained urine was extracted, but the hypogastric globus remained, in spite of some decrease in convexity.

Rectal examination showed a voluminous prostate of normal consistency and surface. Above it, a tumor with a hard and distended surface was discovered. To combined rectohypogastric palpation the tumor was spherical and very hard.

The right hypochondrium was the site of a deep scar, which was derived from a previous renal operation for echinococcus cyst. The diagnosis was retrovesical echinococcus cyst.

*Cystographic Study:* Only 150 cc. of contrast medium could be introduced; nevertheless the cystogram, in the anteroposterior projection, showed an enormously enlarged bladder, with more liquid at its periphery than in its center. The catheter was displaced from the median line and bent to one side.

The lateral projection showed the peripheral distribution of the liquid. The catheter was bent forward; the cyst appeared to be a roundish mass pushing from behind and sinking into the bladder.

*Pneumocystographic Study:* When the contrast medium was replaced with a negative contrast (filtered air) a still clearer picture was obtained. There was scanty filling of the bladder. The posterior wall was inverted; that is, it became anteriorly convex because it was pushed by the roundish mass that made the catheter bend forward. The mass was spherical and appeared to be about the size of an infant's head.

A new rectal examination, subsequent to the other, combined rectohypogastric one, added nothing to the original findings—that is, it was impossible to estimate the resistance of the mass in order to make a positive diagnosis of retrovesical cyst. In spite of the distinct hardness of the tumor and the failure of resistance perception, a diagnosis of echinococcus cyst was made, largely on the basis of the previous operation for renal echinococcus. (This operation had been done six years before at the Surgical Clinic, University of Bari.)

Once the diagnosis was established the essential question arose: Should the cyst be approached through the perineum or through the abdomen? Though the tumor was easily palpable through the rectum, I preferred the direct, upper, suprapubic approach.

In contradistinction to the opinion of most authors (e.i., Albarran), who prefer the abdominal or intraperitoneal approach, I was able to reach the cyst extraperitoneally and to separate, very carefully, the peritoneal plica from the vesical walls. Having reached the cyst, I was able to expose 0.5 to 1 cm. of its superior wall; then I followed Posada's classic treatment: aspiration of the liquid and replacement of it with solution of formol; opening of the cyst, extraction of the poligerous membrane; marsupialization, and drainage.

The postoperative course was excellent. After 15 days the patient got up; after a month drainage was discontinued; after 50 days he was surgically recovered and the bladder had regained its normal function.

## SUMMARY

This was a case of subperitoneal retrovesical echinococcus cyst following, after six years, a renal echinococcus cyst. The case is instructive because it shows once more that these

prevesical cysts originate not from scolices that reach the prevesical cellular region hematogenically (Walter, Tuffier, etc.) or cross the rectal wall (Charcot) as was formerly believed, but from scolices that drop into the peritoneum at the moment a renal or epiploic cyst is opened incautiously. These cysts have the same origin as intraperitoneal cysts, because the scolices that drop into the serosa migrate through the same into the subperitoneal cellular tissue, according to the mechanism of foreign bodies studied by Marchand and Deve.

In fact, the occurrence of these prevesical cysts is generally simultaneous with or successive to renal or epiploic cysts. Consideration of practical consequences is important. The surgeon who is operating on a renal echinococcus cyst must take every possible precaution to avoid dropping of pathogens into the abdomen.

RIASSUNTO

Espone un caso clinico di una voluminosa cisti idatidea retrovescicale. Dimostra l'interesse del caso non solo dal lato clinico, per il quale la cistografia e lo pneumocisti hanno consentito una diagnosi certa ed un intervento felice; non solo dal lato eziopatogenetico a sostegno della teoria di Devé, dell'insemenzamento del peritoneo e della migrazione degli scolici dal peritoneo nel cellulare sottoperitoneale, contro le vecchie teorie dell'infezione ematogena (Walter, Tuffier) o della migrazione attraverso il retto (Charcot); ma sopratutto dal lato pratico. Infatti il chirurgo operando una cisti addominale deve prendere tutte le possibili precauzioni per evitare la caduta degli scolici nel sacco peritoneale.

SUMARIO

Se ha presentado un caso de quiste retrovesical debido al equinococo y que aparecio despues de seis anos de haber el paciente sufrido de un quiste renal de igual etiologia. Este caso es instructivo porque muestra que estos quistes vesicales no se deben a infestaciones que se han propagado por la via sanguinea (Walter, Tuffier, etc) o por la pared rectal (Charcot); son mas bien debidos a contaminaciones directas del peritoneo durante el momento en que se abren quistes renales o epiploicos con poca precaucion. Estos quistes por lo tanto tienen el mismo origen que los quistes intraperitoneales, y su mecanismo de propagacion es directamente del peritoneo a los tejidos celulares subperitoneales, siguiendo asi el mismo metodo de propagacion que los estudios de Marchand y Deva han confirmado en general con respecto a cuerpos extraneos. Es aun mas un hecho que los quistes prevesicales equinococos generalmente, ocurren simultaneamente o siguen a quistes renales o epiploicos. Esto es de consecuencia muy practica, por cuanto el cirujano que e ta operando un quiste equinococo renal debe de tomar toda clase de precauciones para evitar la contaminacion del abdomen.

SOMMAIRE

Le cas rapporté par l'auteur est très intéressant parce qu'il dèmontre de nouveau que ces kystes prévésicaux ont leur origine, non dans des larves transportes par le sang ou propages à travers les parois rectal es, mais des scolices tombant dans le péritoine au moment de l'ouverture du kyste. Ces kystes ont la même origine que les kystes intrapéritoneaux parce que les scolices tombent sur la séreuse, se déplacent dans le tissu cellulaire sous-péritonéal d'après le mécanisme étudié par Marchand, des corps etrangers (Deve).

En réalité ces kystes prévésicaux sont généralement simultanés ou consécutifs aux kystes rénaux ou épliploïques. Celà est d'une importance essentielle et le chirurgien qui opère sur un kyste échinocoque, prendra toute précaution pour éviter de laisser tomber des germes dans l'abdomen.

# Surgery of the Inferior Oblique Muscle of the Eye

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THE presence of an anomaly of one of the vertically-acting muscles and particularly of an overacting inferior oblique is much more frequent than is usually believed. In Anderson's series of cases an inferior oblique muscle was overactive in 30 percent, and an additional 25 percent showed paresis of at least one of the superior muscles, the horizontal deviation actually being a secondary phenomenon.[1]

The frequency of overaction of the inferior oblique and the "apparent" absence of other pareses recall to mind that in ocular paralyses the findings are essentially different in successive stages of the condition. In the early phase of a muscular paralysis, an overaction of the homolateral antagonist occurs, often associated with an overaction of the contralateral synergist. For example, a paralysis of the right superior rectus produces an overaction of the right inferior rectus (antagonist) and of the left inferior oblique (agonist); similarly, a paralysis of the left superior oblique causes an overaction of the left inferior oblique and of the right inferior rectus. From this, it is readily comprehended that the overacting left inferior oblique may be due to a paralysis of the right superior rectus or of the left superior oblique. The completeness with which the primary lesions of these muscles may recover explains the inconclusive debates between Duane and Bielschowsky and between White and Davis as to the frequency of involvement of the superior rectus versus that of the superior oblique.

At a later stage in the paralysis, a secondary contracture of the homolateral antagonist and synergist develops. In a paresis of the right superior rectus, a secondary contracture of the right inferior rectus and right inferior oblique occurs.

Finally, at the postparetic stage, the palsied muscle may have completely recovered, leaving the homolateral contractures and often an inhibitional palsy of the contralateral antagonist. The late finding of an inhibitional palsy affecting the left superior oblique explains better than any other the difficulty of determining the original primary paralysis, since a superior rectus paralysis ultimately causes weakness of a superior oblique, and conversely a primary lesion of a superior oblique, ultimately a weakness of a superior rectus. From what has been said, an overacting left inferior oblique will be found in early paresis of a right superior rectus or of a left superior oblique; in a later stage of paresis of a left superior rectus or of a left superior oblique and finally an underaction of the same muscle, results in the postparetic stages of a right inferior rectus palsy.

To add to the confusion, all instances of apparent overaction of an inferior oblique are not postparetic. Primary overaction *(Ueberfunktion)*, which is believed to be mostly congenital, is characterized by the absence of vertical deviation in the primary position or in convergence, by no secondary contractures; by the upshoot of the adducted eye in lateroversion, and by the enlargement of the unilateral or bilateral field of ocular fixation in the direction in which the inferior oblique acts best as an elevator.[7] From a therapeutic viewpoint, the importance lies in the fact that there is an overaction, for example, of a right inferior oblique and not a weakness of a left superior rectus. In these cases, the increase of vertical separation when the head is tilted downward toward the opposite side is decisive for a diagnosis of disturbance of the inferior oblique.

*Surgical Anatomy of the Inferior Oblique Muscle:* The short, fleshy inferior oblique muscle has its attachment of origin in a small depression, a little behind the lower orbital rim, approximately 3 mm. below and lateral to the upper orifice of the nasolacrimal duct.

The muscle passes backward and laterally, in a direction making an angle of 50 degrees with the visual line and in a plane slightly more sagittal than the muscle plane of the reflected tendon of the superior oblique. In the

region of the inferior rectus, the muscle sheath becomes more important because it projects a falciform expansion temporally, becoming attached to the orbital wall near the lower lateral angle of the orbit, immediately behind the orbital rim. This aponeurotic formation, which has been considered as the check ligament of the inferior oblique, acts not only in the contraction and relaxation of the muscle but also modifies the muscle action during active pull.

The muscular fibers end with or without a short tendon in the lower temporal quadrant of the posterior hemisphere of the globe. The line of insertion is convex on its upper surface, almost coinciding with the horizontal meridian of the eye, and is entirely covered by the lateral rectus muscle. At its termination, a group of fibers creates adhesions between the inferior border of the lateral rectus and the thickened anterior border of the sheath of the inferior oblique. The well-developed arciform expansion, 10 mm. in length and 4 mm. in width, connects the muscle to the inferior orbital septum, behind which lies orbital fat.

The nerve of the inferior oblique muscle, a branch of the oculomotor nerve, enters the muscle by its posterior border, between two orbital fat expansions, near the lateral border of the inferior rectus.

*Clinical Physiology of the Inferior Oblique Muscle:* In contemporary writings, the inferior oblique is classified as an abductor, on the assumption that its plane passes posterior to the vertical axis of rotation, as does the superior oblique. Actually, however, the plane of the inferior oblique is anterior to the vertical axis of rotation.

As Fischer[12] has shown, extreme positions of rotation of the eyes are the exception in practice, as motions of the head supplement ocular movements of fixation. With this in mind, the true action of the inferior oblique muscle from the primary position is all-important.

In general, extraocular muscles do not act alone, even in purely horizontal movements; auxiliary actions of the vertical muscles will be required to neutralize the small components of elevation, depression and torsion. Even if the muscle were to contract, the location of its muscle plane would be constant only if the muscle action were undisturbed or counteracted by an exactly antagonistic action. Neither of these two conditions will be fulfilled, because of the resistance of the system of suspension of the eye and because pure antagonists do not exist.

*Pathological Dynamics of the Vertical Deviations:* The disturbances of the vertical motor muscles have been classified by Bielschowsky[7] into five groups.

1. *Pure comitant vertical deviations* of pure hyperphoria, which are anomalies of the position of rest. The angle of deviation remains practically constant in all directions of the visual lines, but continuous fluctuations of the compensatory innervation may occasionally simulate paretic lesions.

2. Typical cases of *vertical paretic deviation* are fairly simple to diagnose. In an involvement of the rectus muscles the vertical deviation increases in abduction of the paretic eye, whereas when the obliques are defective the vertical deviation increases in adduction of the eye. In the atypical secondary phase of paresis, the diagnosis becomes difficult and at times impossible, when the paretic muscle regains its function, but the vertical deviation persists as a result of the secondary contractures.

3. The *vertical upshoot of the adducted eye in lateroversion,* either on one side or on both sides, as fixation is transferred to the fellow eye, is due to overaction of the inferior oblique muscles. In the pure primary form there is no disturbance of the muscle balance of the eyes in the primary position. In the diagnostic oblique position of the eyes, however, there is an upshoot of the left eye in dextroversion or a similar upward deviation of the right eye in levoversion. In its secondary form the overaction of the inferior oblique may be part of a delayed symptom of trochlear palsy.

4. The *dissociated vertical deviations,* also called alternating or double hyperphoria, are often combined with comitant deviations.[6] They have been reported in 41 percent of all cases of congenital or acquired amblyopia of one eye. In these deviations, when the eye with the upward deviation fixes and the fellow eye is covered, the eye which has just been covered makes a slight downward movement, accompanied by a similar movement of

the uncovered eye, but immediately after the latter has gained fixation, the covered eye shows an isolated upward movement.

5. The last group of vertical motor anomalies include the *combined vertical deviations*, i.e., those having the characteristics of several of the other groups.

## Indications for Operations on the Inferior Oblique Muscle

The surgical correction of vertical motor anomalies includes[18]: (1) strengthening of the paretic muscle; (2) weakening of the associated antagonist; (3) weakening of the direct antagonist and (4) transplanting a portion or a whole active muscle to give motion in a field where it is absent. If fusion is present, even in a limited field, the paretic muscle should be strengthened in preference to weakening the spastic one.

Several measures may be wisely performed in the same operation. For example, it may be advisable to shorten the superior rectus when the inferior oblique muscle is lengthened, in order to obtain a more advantageous correction of the eye in the primary position.

*A. Indications for Weakening (Lengthening) the Action of the Inferior Oblique Muscle:* 1. A unilateral or bilateral hyperphoria or hypertropia, caused by congenital or acquired but stable underaction, paresis or paralysis of the contralateral superior rectus muscle, with or without spasm of the inferior rectus of the opposite eye, depending upon which eye is used for fixation:[10, 13] If the paretic eye fixes, the secondary deviation of the contralateral eye is pronounced; a recession of the contralateral inferior oblique is combined with a recession of the contralateral superior rectus. If the sound eye fixes, the paretic eye is hypotropic and a pseudoptosis is present, the correction includes an advancement of the homolateral superior rectus and a resection of the homolateral inferior oblique.

2. A unilateral or bilateral hyperphoria or hypertropia due to paresis or paralysis of the superior oblique with secondary spasm of the inferior oblique of the same eye: These cases are usually traumatic.

3. An esohypertropia due to a paresis or fibrosis of the lateral rectus with secondary compensatory spasm of the inferior oblique of the same eye: This spasm does not occur in paresis of the lateral rectus unless there is a predisposing vertical anomaly of divergence.[10]

4. A unilateral or bilateral hyperphoria or hypertropia associated with a primary or secondary overacting inferior oblique muscle in the same eye (upward rotation of the adducted eye in lateroversion): This occasional deviation can be elicited only by testing the eyes in the cardinal positions of gaze.

*B. Indications for Strengthening (Shortening) the Action of the Inferior Oblique:* When it is desirable to strengthen the action of the inferior oblique, the muscle may be resected or tucked at the scleral attachment or advanced at the orbital margin.

1. A hypotropia associated with a homolateral pseudoptosis, in which the upper eyelid follows the downward rotation of the eye, resulting from a paresis of the inferior oblique: In paralysis of the inferior oblique muscle, binocular vision may be maintained in a large part of the motor field and when the sound eye fixes, the primary deviation may not result in a marked hypotropia.[21] Paresis of the inferior oblique may occur alone or in conjunction with a paralysis of the homolateral superior rectus.[22] In these cases resection or tucking of the inferior oblique and an advancement or tucking of the superior rectus becomes necessary.

2. A hypotropia combined with a cyclotropia due to postoperative paresis of the inferior oblique, especially when fusion exists:[4] Typical cases of this type are observed following the accidental division of the inferior oblique from the sclera in operations on the lateral rectus.

3. A hypotropia associated with lateral strabismus, specially in exodeviations: In such cases, the vertical component is a hindrance to any attempt to establish a solid fusion with amplitude, especially in elevation.

*C. Indications for Transplanting the Inferior Oblique Action:* Transplantation of the inferior oblique muscle so that it acts as a depressor in paralysis of the homolateral inferior rectus has been successfully performed by Wiener.[23] In this isolated paralysis of the oculomotor nerve, the secondary contractures of the inferior oblique and superior rectus produce a marked hypertropia. In this tech-

nic, the spastic elevation is weakened as a certain degree of depression of the eyeball is obtained.

### Contraindications for Operations on the Inferior Oblique Muscle

Operations on the inferior oblique are contraindicated in the following conditions:

1. *In slight vertical deviations,* especially when comitant and readily neutralized by prisms placed in the patient's correcting lenses.[19]

2. *When there are variations in the amount and character of the hypertropia,* e.g., in the early stages of acquired pareses of the vertical acting rectus muscles.[18]

3. *In the absence of a real suppression of the false image,* but no true diplopia is experienced by the patient, because the false image is so far from the true image that it is not disturbing.

4. *When dissociated vertical deviations simulate alternating or double hyperphoria,* although these muscular imbalances do not lend themselves to operative procedures that would correct comitant or paretic deviations.[7] This purely innervational anomaly is best treated by conservative measures and the judicious use of orthoptics.

5. *In malinsertion of the medical rectus,* which is rare, its possibility should be borne in mind when diagnosing an overaction of an inferior oblique.[15] A high insertion of the medial rectus may cause a partial upshoot of the eye in lateroversion.

### Technics of Operations on the Inferior Oblique Muscle

*A. Lengthening (Weakening) Operations*

(1) *Recession of the Inferior Oblique at Its Scleral Attachment.*[20]

A traction suture is introduced in the episcleral tissue near the limbus at approximately the 8 o'clock position for the right eye, exposing the lower temporal quadrant. With blunt scissors, a curved incision is made in the conjunctiva, starting 4 mm. below the lower edge of the lateral rectus and ending at the upper border of the same muscle, 14 mm. from the limbus (Fig. 1).

Tenon's capsule is opened. A strabismus hook is then introduced under the lateral rectus which is pulled upward. The inferior oblique is seized 6 mm. from its attachment by means of fixation forceps.

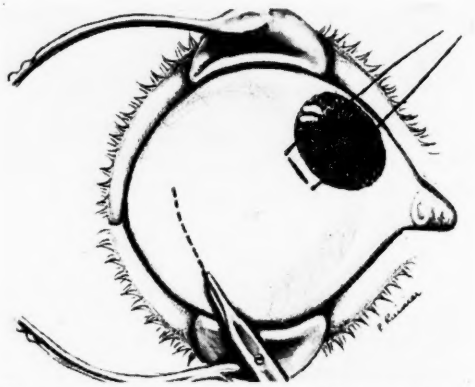

Fig. 1. Recession of the inferior oblique muscle at its scleral attachment. A curved incision is made in the conjunctiva, starting 4 mm. below and ending at the upper border of the lateral rectus muscle, along the equator of the eyeball (14 mm. from the limbus).

Two double-armed sutures are introduced in the muscle 4 mm. apart, as close to the attachment as practicable. A mark is made by slight pressure on the sclera along the edge of the muscle at the desired distance from the attachment, using the points of the calipers as a marker. One needle of the double-armed suture is introduced through the superficial layers of the sclera at the marked point (Fig. 2). Similarly, a needle of the other suture is placed on the other side of the muscle.

The muscle is severed from its attachment to the sclera and allowed to slip downward as the sutures are tied securely along the new line of insertion (Fig. 3).

The lateral rectus is replaced in its normal position.

The conjunctiva is closed by means of single continuous plain catgut suture.

(2) *Myectomy (or Myotomy) of the Inferior Oblique Near Its Orbital Attachment.*[8]

The division or recession of the inferior oblique muscle near its orbital origin may be done by two different routes.

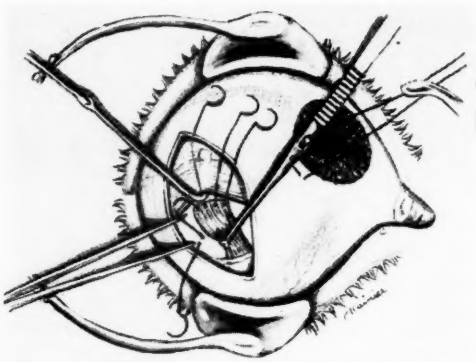

Fig. 2. Recession of the inferior oblique muscle at its scleral attachment. The lateral rectus is drawn upward. The inferior oblique is seized with a fixation forceps. Two double armed sutures are inserted 4 mm. apart, near the attachment of the muscle. Using calipers, the measurement of the desired recession is marked on the sclera along the muscle border, and the needle is introduced in the episclera at this point, prior to the division of the muscle from its scleral insertion.

*a. Transcutaneous Approach:*[14] An incision 20 mm. in length is made through the skin, over the inferior orbital rim, so that its central point is in the same vertical sagittal plane as the pulley of the superior oblique muscle.

By blunt dissection, the fibers of the orbicularis are spread apart, exposing the inferior orbital septum, which is incised for a distance of 15 mm. The inferior oblique lies in close proximity.

A strabismus hook is introduced at the temporal end of the incision with its tip in constant contact with the floor of the orbit. The hook is then turned so that its concavity is toward the nose and a sweeping motion is made upward and inward. When resistance is felt, the hook is brought forward, the tip first emerging from the wound, drawing with it the inferior oblique.

The exposed portion of the muscle is freed from all fascial adhesions for about 6 mm. Muscle forceps are applied 5 mm. from the orbital floor. In a myotomy, a single division is made proximal to the muscle forceps. In a myectomy, the first division is made with blunt scissors as close as possible to the periosteum (Fig. 4). A second division of the muscle is made distal to the muscle forceps. A 4 mm. excision of the muscle prevents a possible reattachment of the cut section to the orbital floor.

The opening in the orbital septum is closed with a continuous plain catgut suture. The skin edges are approximated and a continuous subcuticular suture inserted.

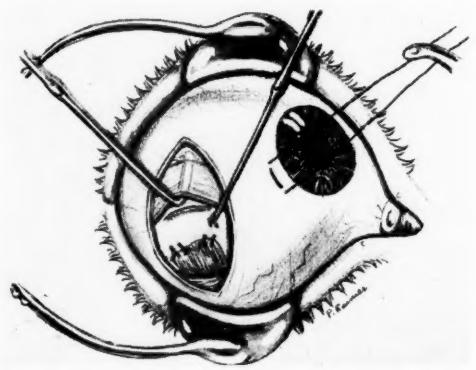

Fig. 3. Recession of the inferior oblique muscle at its scleral attachment. After division, the muscle is allowed to slip downward as the two sutures are tied, holding the inferior oblique in its new recessed position.

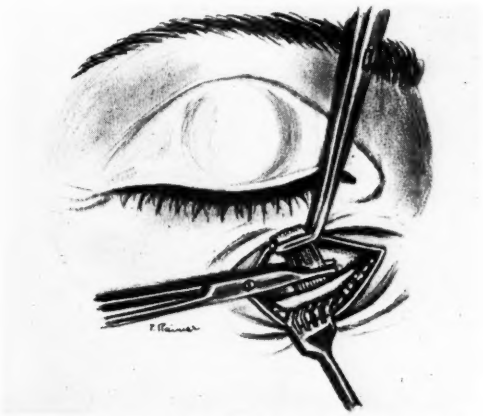

Fig. 4. Myectomy of the inferior oblique muscle at its orbital attachment by transcutaneous approach. The skin wound is spread open with rake retractors. A muscle forceps has seized the inferior oblique 5 mm. from the floor of the orbit, while the first division of the muscle is made with Stevens scissors.

*b. Transconjunctival Approach:*[9,16] A traction suture of black silk is inserted in lower eyelid near the margin. Another traction suture is inserted at 6 o'clock in the conjunctiva and episclera at the limbus. By opposing pulls on these sutures, the conjunctival cul-de-sac is completely exposed. An incision 15 mm. in length is made at the lowest part of the cul-de-sac (Fig. 5). The dissection is carried downward and slightly inward toward the orbital rim.

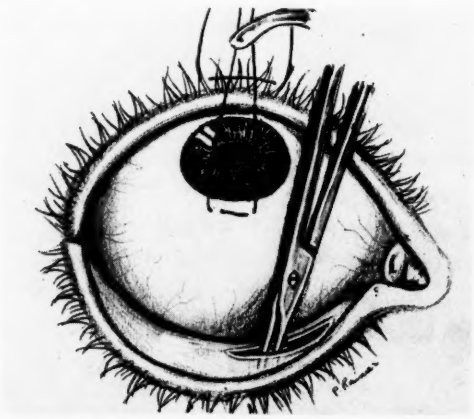

Fig. 5. Myectomy of the inferior oblique muscle near its orbital attachment by transconjunctival approach. Traction sutures are spreading the eyelids apart, as the eye is forcibly turned upward. An incision 15 mm. in length is made deep in the lower cul-de-sac; its center is on the same vertical plane as the trochlea. The dissection is carried downward and inward toward the orbital margin.

A strabismus hook is then introduced in the conjunctival incision, its tip is made to rest on the orbital floor at the temporal extremity of the wound. A sweeping motion is then made so that the concavity of the hook is toward the nose. The hook is moved upward, as the inferior oblique is brought into the wound.

The strabismus hook is replaced by muscle forceps. A division is then made on each side of the muscle forceps. The conjunctival wound is closed with a continuous catgut suture.

*B. Shortening (Strengthening) Operations*

(1) *Resection of the Inferior Oblique at Its Scleral Attachment.*[5]

A traction suture is inserted in the episclera near the limbus in the lower temporal sector. The eye is rotated upward and nasally.

A curved incision is made in the conjunctiva, below the level of the tendon of the lateral rectus, along the equator of the eyeball. Tenon's capsule is opened below the lower border of the lateral rectus. A suture placed through the lower edge of the lateral rectus retracts the muscle upward, so as to expose the inferior oblique muscle. A bipronged scleral hook[3] is used to create direct traction on the sclera, fully exposing the muscle.

The inferior oblique is grasped with special muscle forceps[2] at a distance from its attachment equal to the amount of resection desired. Two double-armed sutures are introduced from the conjunctival surface of the muscle and passed through the special grooves of the forceps (Fig. 6).

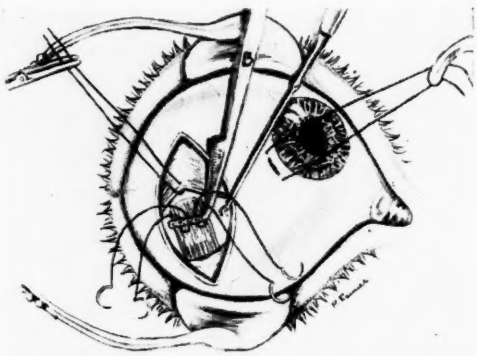

Fig. 6. Resection of the inferior oblique muscle at its scleral attachment. The lateral rectus is retracted upward; the eyeball is immobilized with a bipronged scleral hook. A special muscle forceps is placed on the muscle at a distance from the attachment equal to the resection desired. Two double armed sutures are inserted.

The portion of the inferior oblique between the scleral attachment and the muscle forceps is resected. While the special muscle forceps are still in place, the four needles of the double-armed sutures are passed through the remaining stump at the anatomical insertion of the muscle (Fig. 7). The muscle forceps are removed.

The sutures are tied securely and cut (Fig. 7, insert). The conjunctival incision is closed with a continuous suture.

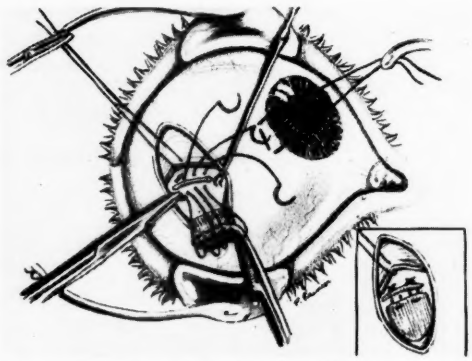

Fig. 7. Resection of the inferior oblique muscle at its scleral attachment. The inferior oblique muscle has been resected between the muscle forceps and the scleral attachment. The sutures are inserted through the stump of the anatomical insertion. *In insert*: The sutures are tied.

(2) *Tucking of the Inferior Oblique Near the Scleral Attachment.*[20]

With blunt scissors a curved incision is made in the conjunctiva below the border of the lateral rectus, which is drawn upward, exposing the inferior oblique. A strabismus hook is inserted under the muscle. As the hook is pulled away from the globe, it raises a fold, through which one or two double-armed sutures are inserted (Fig. 8) to secure union between the opposed flat surfaces of the tendon. The height of the fold above the suture determines the amount of actual shortening produced. The sutures are tied securely. The conjunctival wound is closed with a continuous plain catgut suture.

(3) *Advancement of the Inferior Oblique at the Orbital Rim.*[17]

A cutaneous incision is made along the inferior orbital rim, so situated that its central point is in the same vertical sagittal plane as the pulley of the superior oblique muscle. The fibers of the orbicularis are separated by blunt dissection. The orbital septum is then incised.

A strabismus hook, introduced at the temporal end of the incision, engages the inferior

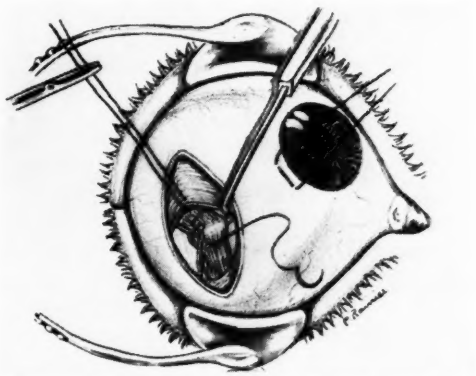

Fig. 8. Tucking of the inferior oblique muscle near its scleral attachment. The lateral rectus is drawn upward to expose the attachment of the inferior oblique. A strabismus hook is introduced under the muscle, lifting a fold, through which the sutures are placed.

oblique muscle which is brought out into the wound. The dissection is also carried downward for exposure of the periosteum 10 mm. or more below the orbital margin (Fig. 9).

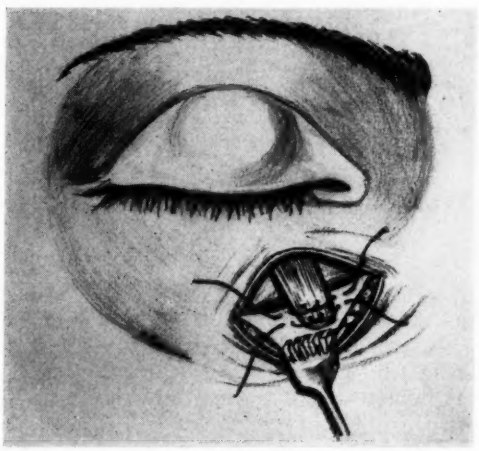

Fig. 9. Advancement of the inferior oblique muscle at the orbital rim. Through the cutaneous incision at the orbital rim, the inferior oblique is charged on a strabismus hook.

Two chromic catgut sutures are passed through the tendon near its attachment, while

the muscle is stretched on a strabismus hook. The inferior oblique is cut free from its attachment. It is advanced as much as is necessary and secured to the periosteum anterior to the rim on the facial surface of the superior maxilla by means of the chromic sutures prior to the division (Fig. 10).

The orbital septum opening is closed with plain catgut sutures and the skin wound with a subcuticular silk suture.

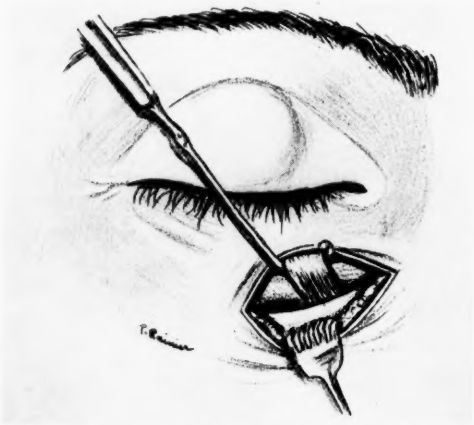

Fig. 10. Advancement of the inferior oblique muscle at the orbital rim. The severed inferior oblique is advanced as needed and secured to the periosteum of the facial surface of the superior maxilla by means of sutures.

### *C. Transplantation of the Inferior Oblique Muscle*[23]

A curved incision is made in the conjunctiva with blunt scissors, extending from above the lateral rectus to a point deep in the lower cul-de-sac over the inferior rectus. Tenon's capsule is grasped lateral to the border of the inferior rectus and a strabismus hook is introduced under the muscle.

Tenon's capsule is also entered at the lower border of the lateral rectus. The muscle is then retracted upward, exposing the attachment of the inferior oblique.

The special muscle forceps are placed approximately 12 mm. from the orbital attachment. The muscle is severed from the scleral insertion and the excess of muscle distal to the forceps is resected. Two double-armed chromic catgut sutures are inserted through the guides in the special forceps. The loose muscle is pulled medially into the conjunctival wound.

The needles are then introduced in the episcleral tissue nasal to the attachment of the inferior rectus, approximately 3 mm. from the limbus. The sutures are tied securely and cut close to the knots (Fig. 11). The conjunctiva is then closed with a continuous suture.

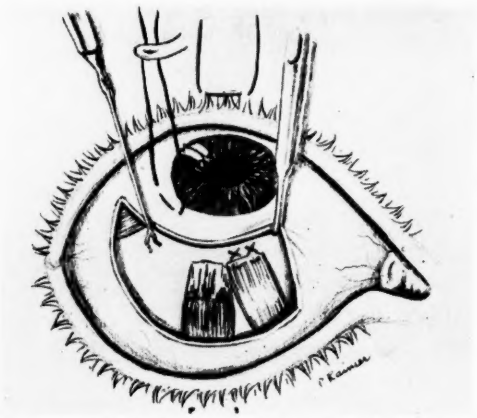

Fig. 11. Transplantation of the inferior oblique muscle to act as a depressor. Through a wide inferior conjunctival incision, the inferior oblique severed from its attachment to the sclera, under the lateral rectus is brought medially and sutured near the limbus along the paralyzed medial rectus.

## DISCUSSION

Thirty-eight operations on the inferior oblique muscle have been performed on 31 patients. They are grouped as follows:

*Lengthening operations:*

| | | |
|---|---|---|
| Simple recession at the scleral attachment | 15 | 29 |
| Bilateral recession at the scleral attachment | 4 | |
| Simple graduated myotomy near the scleral attachment | 2 | |
| Bilateral graduated myotomy near the scleral attachment | 1 | |
| Myectomy near the orbital attachment | 2 | |

*Shortening operations:*

| | | |
|---|---|---|
| Simple resection at the scleral attachment | 5 | 9 |
| Tucking near the scleral attachment | 4 | |

The author's preference for an approach to the inferior oblique at its scleral attachment over that at its orbital attachment is clearly indicated in these cases by the ratio of 36 to 2 in favor of the scleral approach. The latter permits the detailed study of the insertion and the technic to be modified according to the individual case. The same conjunctival incision may be used, when associated operations are necessary and may be undertaken at the same time as the inferior oblique displacement.

It seems desirable to sever the muscle as close to the attachment as possible; this eliminates the possibility of disturbing the innervation, which enters the muscle from its posterior edge just after it passes the inferior rectus at the ligament of Lockwood.

The effects of a myectomy of the inferior oblique orbital attachment have been variously reported. The author's findings are more in line with those of Berens,[4] who claimed 5.3 prism diopters of correction in the primary position at 6 meters and 7.7 prism diopters at 25 cm., reaching 11 prism diopters in the field of vertical action of the muscle. The myectomies reported here resulted in a correction of 6 prism diopters of hypertropia in the primary position of the eyes. When extremely small hypertropic corrections are necessary, myotomy or myectomy in the sheath of the inferior oblique muscle[19] appears especially indicated.

The literature contains little information on the results obtained from a measured displacement of the scleral insertion of the muscle. In this series, a 1 mm. recession of the muscle did not give a uniform hypertropic correction of approximately 1 prism diopter, but varied with the total amount of the attempted recession. In recessions of small amounts, the findings parallel those of Berens,[4] that is, 1 mm. of retroplacement gives a 1 prism diopter correction of hypertropia in the primary position of the eyes, but as the amount of recession increases this relationship alters. In recessions of from 6 to 7 mm., the average result obtained varied between 10 and 13 prism diopters of hypertropic correction or from 1.4 to 2 prism diopters per millimeter of retroplacement. In the group of 10 mm. recessions, the results varied between 1.5 to slightly over 2 prism diopters per millimeter of displacement. It can be said, therefore, that when the opposing vertical muscles to the recessed inferior oblique are normal clinically, in the small amounts of recession the relation is 1 mm. for every 1 prism diopter, increasing to 2 prism diopters for each millimeter in the larger recessions. The results can be seen in the accompanying table.

Relationship between the Recessions in Millimeters of the Inferior Oblique on the Sclera and the Correction of Hypertropia in the Primary Position

| Recession in mm. on sclera | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|
| Correction of hypertropia in prism diopters | 3 | 4.8 | 6.5 | 8.3 | 12 | 14 | 17 | 20 |

In resections of the inferior oblique muscle, the effect of every millimeter of displacement appears slightly larger than for the small amounts of recessions and approximately the same in the large amounts. It can be said, as a rule, that 1 mm. of resection will correct 1.5 prism diopters of hypotropia. For tuckings, the result is definitely a great deal smaller, usually 0.7 prism diopters per millimeter of tuck, which explains why this operation was discarded even by some of its earlier advocates.

A study of these cases indicates that combining the vertical and horizontal correction made the latter less extensive in the amount of resection and recession than it would have been without the neutralization of the hypertropia. This finding has been recognized at an early stage in many cases, and the suggestion has been made that often the vertical component is the prime factor in the strabismus.

The relatively insignificant number of cases of postoperative cyclophoria or cyclotropia may be explained by the fact that the torsional component of the inferior oblique action is kept relatively the same by the action of the so-called check ligament of the muscle, which is not modified by the operation.

## SUMMARY

The inferior oblique is accessible not only to recessions but also to resections, tucking and even transplantation of muscle fibers for muscle paralysis.

Surgery should be done at the insertion of the inferior oblique rather than at its origin because of its easy approach and the nature of the anatomy. Fusion of the fascial sheaths of the inferior rectus and inferior oblique at the tendon of Lockwood, even though not intimate, may nullify to a variable degree the operative results if the operation is done at the bony origin.

Weakening of the inferior oblique action is recommended in the contralateral eye when there is a paresis of a superior rectus muscle and fixation with the paretic eye. It is also advisable in secondary spasm resulting from a paresis of the superior oblique of the same eye; in primary overaction of the inferior oblique muscle, combined with an upshoot of the adducted eye, and destroying comitance in fields of oblique gaze; and finally, in fibrosis of the lateral rectus with compensatory spasm of the inferior oblique of the same eye.

Strengthening the action of the inferior oblique is indicated in paresis of the muscle, especially when associated with pseudoptosis of the affected eye. The paresis of the inferior oblique may be congenital, often associated with a weakness of the homolateral superior rectus, or acquired, following excessive myectomy or recession of the muscle.

The results obtained from calibrated recessions and resections are somewhat different from published accounts. To equal increments of the displacement on the sclera correspond approximately constant increments in hypertropic correction.

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# Suppuration: A Rare Complication After Goiter Excision

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ALTHOUGH there are many postoperative complications resulting from excision of a goiter (such as tetanus, bleeding or injury to the recurrent nerve), suppuration represents a comparatively slight danger. In most cases suppuration appears about the ligature or about the sutures placed in the platysma, sternohyoid or sternothyroid muscles. However, there are cases in which it begins deeper and thus threatens the life of the patient. In such cases it frequently involves the deep cervical fascia and also the bodies of the cervical vertebrae. An accurate diagnosis is of paramount importance, for the fate of the patient depends upon it. Fever and leukocytosis may suggest that suppuration exists, but they tell nothing about its site and extent.

## CASE REPORTS

*Case 1:* A woman, aged 20, was operated on for goiter. On the sixth postoperative day, fever developed; it continued for four days. The leukocyte count was 12,000. There were pains radiating to the right arm, a stiff neck and a tilted cervical column.

The wound was exposed with the patient under intravenous anesthesia. Severing of the platysma, sternohyoid and sternothyroid muscles followed. The sternocleidomastoid having been retracted laterally, and the stump of the goiter and the gullet medially, the deep cervical fascia appeared (Fig. 1). There was an area of suppuration measuring 3.2 cm. at the level of the fifth and sixth cervical vertebrae. After the necrotic fascia had been removed, it was observed that the process had involved the bodies of the two vertebrae mentioned. The diseased bone was curetted and tamponed, after which penicillin was locally administered. Complete recovery resulted in two weeks.

*Case 2:* A man, aged 55, was operated on for retrosternal goiter causing tracheal compression. During the operation it was necessary to perform tracheotomy because of the collapse of the air pipe. In spite of treatment with penicillin (400,000 O. U.), fever developed on the tenth day and the patient had a rigid neck. Permission for a second operation was refused. The general condition became worse; there was much sputum, suggesting a pulmonary abscess. Penicillin was employed again, with no result. On the thirty-fourth postoperative day the patient died. Necropsy revealed a suppurative process resembling that in Case 1, besides a perforation into the gullet through an opening 1.5x1.0 cm. (Fig. 2).

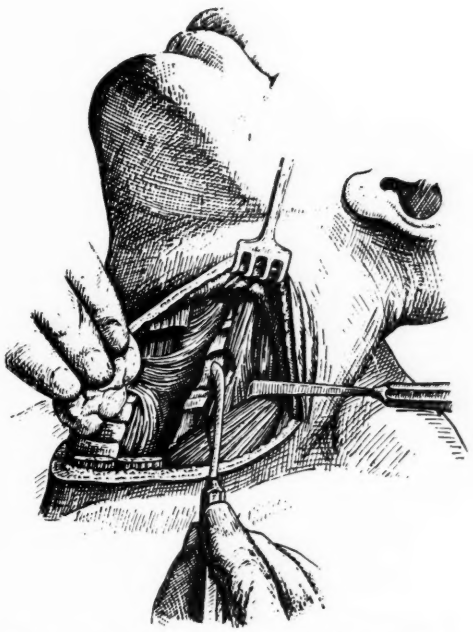

Fig. 1. Exposure of deep cervical fascia by retraction.

## SUMMARY

Ten days after a goiter operation, if the patient develops a fever, a stiff neck, pains radiating to the arms (due to a collateral edema around the intervertebral foramen)

Fig. 2. Perforation into the gullet revealed at necropsy (Case 2).

necrosis of the deep cervical fascia and osteomyelitis of the vertebra should be suspected.

In daylight, an anteroposterior film yields much information. The laterolateral film may show decay of the bone structure, pointing to osteomyelitis. In this condition the hazard of operation is negligible as compared to that of delay, which may be fatal, causing perforation into the esophagus, mediastinitis and sepsis. Early excision of necrotic fascia and diseased bone is likely to result in complete recovery.


RIASSUNTO

Bisogna sospettare una necrosi della fascia cervicale profonda ed un'osteomielite delle vertebre ogni qualvolta un operato di gozzo presenta—10 giorni dopo l'operazione—febbre, rigidita' del collo, dolori irradianti verso le braccia (per edema collaterale intorno i fori intervertebrali). Radiografie prese in senso antero-posteriore facilitano molto la diagnosi: quelle in senso laterale permettono talvolta di rilevare un'osteomielite delle vertebre. Se questa complicazione si manifesta, il pericolo di un nuovo intervento operatorio e' trascurabile di fronte all'eventualita' di una perforazione nell' esofago, mediastinite e sepsi. Una completa guarigione puo' essere ancora ottenuta mediante l'escisione della fascia necrotica e delle parti ossee ammalate.

SUMARIO

Si el paciente presenta diez dias despues de una tiroidectomia sintomas de fiebre, rigidez del cuello, y dolores radiculares braquiales (debidos al edema colateral de los agujeros intervertebrales) el cirujano debe de sospechar la necrosis de la aponeurosis cervical profunda con osteomielitis vertebral. En el diala radiografia es de gran valor diagnostico la vista latero-lateral puede mostrar la necrosis vertebral indicativa dela osteomielitis. El diagnostico a tiempo disminuye los peligros de la intervencion quirurjica, mientras que el retardo puede ser fatal, por las complicaciones que este acarrea, tal como la perforacion del esofago. la mediastinitis, y la septicemia. La excision temprana del tejido necrotico del hueso afectado muy posiblemente resulta en la mejoria completa.

SOMMAIRE

Si dix jours après l'opération d'un goître, le malade présénte de la fiévre, de la rigidité du cou, des douleurs radiantes dans les bras (dûes à un oedéme collatéral autour du trou intervertébral), il faut songer à la nécrose du fascia cervical profond et à l'ostomyelite de la vertèbre. Un film antéro-posterieur donne beaucoup de renseignements. Un film latérolatéral montrera l'état de l'os, l'ostéomyelite, la nécrose. En présence de cette complication, les hasards de l'opération sont negligeables comparés au delai qui peut entraîner une perforation dans l'oesophage, une mediastinite, une infection généralisée. Une incision précoce du fascia nécrotique et de l'os malade peut donner comme résultat, le rétablissement complet.

# An Operation for Primary Glaucoma: Goniodialysis Combined with Sclerectomy and Iris Inclusion

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IN THE treatment of primary glaucoma, most eye surgeons have done some part of the goniodialysis operation combined with sclerectomy and iris inclusion, many times—the sclerectomy, the iris inclusion or the goniodialysis. My suggestion is that all these procedures be done at one time and that the incision be made *ab externo* as originally advocated by Ernst Fuchs.

The operation is indicated in cases of chronic primary glaucoma either with or without acute exacerbations. It can also be used in cases of intractable borderline secondary glaucoma; that is in the treatment of conditions difficult to classify as true primary glaucoma. Often, in such cases, more than one operation has been done with no permanent control of tension.

This triple operation has been done at Mt. Sinai hospital and at the Manhattan Eye, Ear and Throat hospital, New York City, in 43 cases. Of these patients, 20 were male and 23 were female. Their ages ranged from 43 to 79. The preoperative duration of the glaucoma varied from one year to at least eight years. The tension before operation, with mioties, varied from 30 to 80 (Schiotz).

The visual fields varied from almost normal to telescopic with paracentral scotomas of varying size and enlarged blind spots extending almost to fixation. In no case was the field narrowed or the visual acuity impaired by the operation. None of the patients showed lenticular opacities as a result of the operation. Visual acuity before operation ranged from 5/400 to 20/20.

Some cases have been followed for three years, others for only one month. Three patients who had previously undergone operations for relief of tension were operated on by the method described in this paper. Of these three operations, only one was a failure after eight months. If a patient needed postoperative mioties more than three times a day to keep the tension normal, the operation was considered a failure.)

The operation that failed was performed on a Negro who had syphilis and whose right eye was lost after several unsuccessful operations, including cyclodiathermy, to control the tension. The left eye had undergone one operation for glaucoma, with no reduction in tension. Then the operation described here was performed by the surgeon in charge. The tension was controlled for eight months but rose again and could not be controlled with mioties.

## TECHNIC

The operative procedure is simple and requires no great amount of surgical skill. It can be done with either intravenous or local anesthesia. On the day of the operation I use no mioties; this makes it easier to withdraw the iris from the wound. When local anesthesia is employed I use a lid block according to Van Lint's technic and two sutures through the upper lid and one through the superior rectus. No suture is needed for the lower lid. Two cc. of 2 percent novocain with adrenalin is injected retrobulbarly above and also some subconjunctivally above, ballooning up the conjunctiva between the limbus and the upper fornix.

The incision is made 1 cm. above the limbus and rather wide, as for trephining. Tenon's is also opened rather wide. As one approaches to within 5 mm. of the limbus (Fig. 1), the incision goes through all the layers down to the sclera. This incision must be made wide enough to avoid a small filtration area, which would stand out like a knuckle.

The dissection is carried down to the corneoscleral margin (Fig. 2), and here a partial splitting of the cornea, as for a trephine, may be performed, though it need not be carried into corneal tissue for any considerable distance. With a keratome or a knife, a 5 mm.

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. When the limbus is reached, the final dissection is completed with a Tooke knife so as to expose clearly the corneoscleral margin.

Fig. 2. The *ab externo* scleral incision is made 5 mm. long, with the point of a keratome 2 mm. above the corneoscleral margin until the uveal tissue is reached.

Fig. 3. An iris repositor is then placed in the wound, hugging the inner scleral surface, and gently advanced until the repositor enters the anterior chamber. The repositor is then moved from side to side, freeing the angle (goniodialysis).

incision is made through the sclera 2 mm. above the corneoscleral margin. This line is scratched deeper and deeper until the uveal tissue is reached. If scleral bleeding is annoying, it is easily controlled by applying thrombin topical on an applicator. Then an iris repositor is inserted through the wound, hugging the under surface of the sclera (Fig. 3).

If the repositor does not enter easily, the incision with the keratome is repeated, going a bit deeper this time. The repositor is tried again, and as it enters it is placed gently into the anterior chamber, entering through the iris angle. The repositor is swung gently from side to side, opening the angle over as great an area as possible.

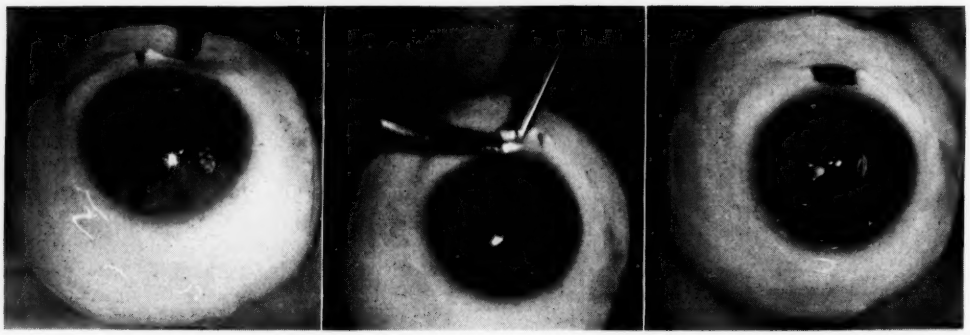

Fig. 4. Fig. 5. Fig. 6.

Fig. 4. Two incisions 3 mm. apart are then made in the sclera towards the corneoscleral margin for a distance of 1 mm.

Fig. 5. This piece of sclera is cut off with scissors to make a scleral opening measuring 3 x 1 mm.

Fig. 6. A scleral tongue 2 x 5 mm. has been excised. This has been made extra large for purposes of demonstration but in actual practice does not exceed 1 x 3 mm.

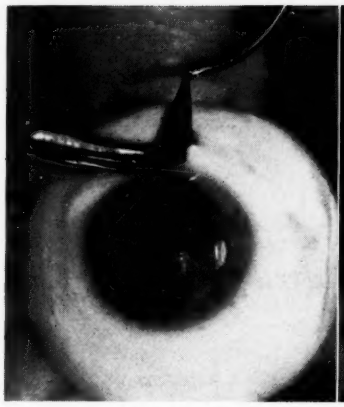

Fig. 7.

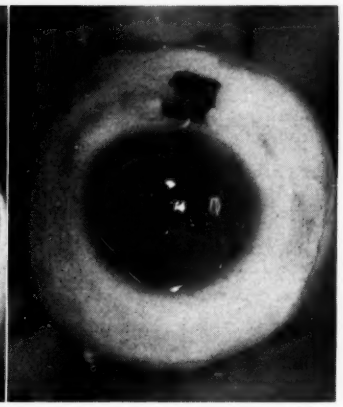

Fig. 8.

Fig. 7. The iris is withdrawn until the black pupillary seam is seen; then it is cut halfway across.

Fig. 8. The iris, which is in the forceps, is allowed to lie on the sclera as it falls. No attempt is made to turn the pigment surface up or face down.

With a Stevens scissors, two incisions are made 3 mm. apart (Fig. 4) at right angles to the original scleral incision, going down to the corneoscleral margin. This piece of sclear is picked up in toothed forceps and excised (Figs. 5 and 6). The iris is then gently grasped with iris forceps near the pupillary margin and, with a gentle side to side swaying motion, is carefully and slowly withdrawn through the scleral wound until the black pupillary portion is visible (Fig. 7).

One incision is made through half of the withdrawn iris to the pupil, and this pillar is allowed to recede. The other portion of the iris, which is still in the iris forceps, is allowed to lie on the sclera just as it falls (Fig. 8). No attempt is made to straighten the iris or to place the pigmented layer of the iris against the sclera. The conjunctiva is now closed with a running silk suture, a knot being tied at both ends and the bites taken rather close together. In this way a tight closure is obtained and the ends of the suture can be cut short. One drop of 1 percent atropine is instilled, and then the eye is bandaged.

## COMMENT AND SUMMARY

I was curious to know what structures my iris repositor traversed as it passed from the scleral incision 2 mm. above the corneoscleral margin into the anterior chamber. I obtained a normal globe from the Eye Bank, made the scleral incision and inserted a piece of black

Fig. 9. Section of eye fixed in Bouin's solution and stained with hematoxylin-eosin. (S) Site of incision. (L) Ligamentum pectinatum. (M) Scleral meshwork. (Sc) Schlemm's canal.

silk suture material along the path of the repositor. The eye was fixed in Bouin's solution, sectioned and stained with hematoxylin-eosin. Figure 9 shows the site of the scleral *ab externo* incision, the suture material entering and passing between the sclera and the ciliary muscle through the ligamentum pectinatum.

Therefore, the goniodialysis succeeds in cutting the trabeculae and freeing any anterior peripheral synechiae that may be present. A filtration tract is thereby formed, connecting the anterior chamber through the angle with the outer surface of the globe. This tract is kept patent by the inclusion of iris tissue in the entire length of the channel. The length of the tract is cut in half by removing a 1 mm. piece of sclera, thus bringing the opening in the sclera directly over the filtration angle. Furthermore, when the iris is withdrawn and cut *after* the sclerectomy, the cut is made directly at its root.

It is of interest to note that an article recently appearing in the Brazilian ophthalmic literature reports an operation of simple goniodialysis executed exactly as I have described it, without sclerectomy and without iris inclusion. The author of the article performed the goniodialysis on four patients, in two of whom the tension was satisfactorily controlled.

RIASSUNTO

La goniodialisi riesce a tagliare le trabecole, liberando ogni possibile sinechia anteriore e periferica. Viene così a crearsi un canalicolo di filtrazione, che connette la camera anteriore con la superfice esterna del globo. Questo canalicolo viene mantenuto pervio mediante un'incisione dell'iride lungo l'intiera lunghezza del canalicolo. Il tragitto viene poi diviso in due, asportando un tratto di 1 mm. di sclera, portando così l'apertura nella sclera direttamente sopra l'angolo di filtrazione. Per di piu', allorquando l'iride viene ritirato e tagliato dopo la sclerectomia, il taglio viene portato direttamente alle sue radici.

L'A. richiama l'attenzione sopra il fatto che nella letteratura brasiliana e' stata riportata di recente un'operazione di goniodialisi simile a quella descritta la Laval, ma senza sclerectomia e senza l'inclusione dell'iride. Sopra 4 pazienti sottoposti a questo genere d'operazione, in 2 l'intervento ha consentito un controllo soddisfacente della tensione.

SUMARIO

Hemos encotrado que la genio-dialisis sucede en cortar las trabeculas y en liberar las sinequias anteriores perifericas que puedan existir. Asi tambien se forma un tracto de filtracion conectando la camara anterior con la superficie exterior del globo ocular. Este tracto se mantiene patente por la incision del tejido del iris en toda la extension del canal. Al removerse un milimetro de la esclera se corta en la mitad la longitud del canal en forma tal que la apertura de este viene a estar directamente sobre el angulo de filtracion. Aun mas cuando el iris es cortado despues de haberse practicado la esclerectomia este corte se puede hacer directamente en su raiz.

Notamos con interes un articulo que aparecio recientemente en la literatura brasilena en que se reporta una operacion de geniodialisis simple tal como la que yo he descrito pero sin esclerectomia e inclusion iridica. El autor de ese articulo practico su operacion cuarto pacientes, en dos de los cuales la tension fue controlada satisfactoriamente.

SOMMAIRE

La gonodialyse a réussi à couper les trabécules et à libérer toute adhérence périphérique antérieure. Un conduit de filtration est ainsi formé joignant la chambre intérieure à travers l'angle avec la surface extérieure du globe. Ce conduit est maintenu ouvert par l'incision de l'iris dans toute la longueur du canal. On resèque un mm. de la sclérotique au-dessus de l'angle de filtration. Ainsi, quand l'iris est enlevé et coupe après le sclérectomie, l'ouverture est faite directement à cette racine.

Il est intéressant de remarquer un article récement publié dans une revue ophthalmique, brésilienne decrivant une opération semblable à celle décrite sans sclérectomie et sans inclusion de l'iris. L'auteur de l'article opéra 4 malades. Dans deux cas, la tension fut controlée avec satisfaction.

# Surgical Treatment of Scrotal Elephantiasis in West Africa

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AMONG the different forms of elephantiasis, the penile-scrotal type is most frequently found in West Africa. It affects both the penis (penile teguments) and the scrotum, or the scrotum alone.

The weight attained by the elephantiasic tumor ranges from 5 to 16 Kg. Most of the patients are natives; no case has been reported in which the patient was a European. The condition occurs most frequently among the bushmen, natives living in isolated communities in the bushlands of French Guinea, the Lower Sudan and the Upper Ivory Coast.

Macroscopically the lesion appears as a hard, toughened mass of tissues, which if it affects the lower limbs is adherent to the muscles. Scrotal elephantiasis appears as a hard, stony bulge.

The penis, when its tegumental layers are involved, appears hypertrophied, only the outer tissues (epidermis and dermis) being affected. In the cases observed by us, as in the majority of cases of scrotal elephantiasis, sectioning of the tissues revealed a firm, tough-textured white mass infiltrating the dermis and hard to the cutting scalpel. The epidermis showed a diffuse keratitis, is thickened and is covered with lumps and crosses. The microscopic picture as observed in our two cases was that of a chronic diffuse dermatitis associated with a lardaceous degeneration of the connective vascular and glandular (sebaceous and sweat-gland) elements of the dermis. Keratosis of the epidermis is more marked in cases of scrotal elephantiasis.

The chronic inflammation occurring in the dermis is due exclusively to a streptococcic infection. The dermatitis develops gradually, constantly spreading and finally leading to the tissue degeneration just described.

In our operative case, the chronic elephantiasic inflammatory process affected a number of anatomic structures. In the scrotum, the epidermis and the dermis, with the dermic elastic fibers, were affected, also the subcutaneous cellular tissue and the dartos, with the skin-lining muscle, its longitudinal fibers and the adjoining elastic fibers.

The cellular connective tissue layer between the dartos and the cremaster muscle was also affected by the elephantiasic infiltration. The tunica erythroida (erythyroid muscular lining membrane) was not affected, nor were the tunica fibrosa and the tunica vaginalis, peritesticular lining membranes. The testes themselves, including the testicular fibrous membrane, the albuginea, were free from elephantiasic changes.

### TECHNIC

1. Apply a hemostat (rubber tube appliance) at the root of the scrotum and outer urethral tract.

2. Cut from the tegumental surface the flap intended to become the wrapping of the penis (gubernaculum).

3. Search for the penis, sunk in the elephantiasic mass. Disentangle it and lift it, together with the flap, onto the outer abdominal wall.

4. Hemisect the tumor.

5. In each half of the tumor, search for the testis. Disentangle the testis and the inguinotesticular tract from the surrounding mass of elephantiasic tissue.

6. Dissect out the lateral flaps which will become the scrotal coating (new plastic scrotum). The size of these flaps depends on the bulk and volume of the testes. Each flap contains, in addition to the outer cutaneous layers (epidermis, stratum lucidum, Malpighi's layer, dermis) a lining layer of elephantiasic tissue three to four mm. thick. This material, because of its hypervascularized structure—it contains a large network of dermic (chorionic) blood vessels—is an important factor in the grafting process, aiding in reepithelization and healing of the operative wound.

7. Lay aside the three flaps and, with the penis and the testes lifted onto the abdomen, perform a deep resection (exeresis) of the two tumor masses.

8. Attend to hemostasis of the blood vessels in the operative field, with gradual and careful slackening and final removal of the hemostat.

9. Suture the flaps, starting at the posterior end of the incision line back to front, by means of Michel's clips.

10. Around the top of the prepuce add a crowning suture of catgut (stitches at uniform intervals). Apply a vaseline-dabbed collarlike gauze dressing to prevent the trickling of urine onto the incision line.

Draining by means of a drainage tube is considered only if hemostasis in the operative field has not been perfectly carried out. Frequently, widespread bleeding on the incision surface occurs when ligation is hampered by slippery, elephantiasic tissues adhering to the tunicae of the blood vessels that require ligation.

SUMMARY

The clinical appearance, pathologic picture and surgical treatment of elephantiasis, especially of the scrotum and the penis, are discussed, with details of surgical technic as worked out by the author's service in West Africa.

RIASSUNTO

Descrive l'aspetto clinico, il quadro patologica e la cura chirurgica dell'elefantiasi, specialmente dello scroto e del pene. I dettagli della tecnica chirurgica sono derivati dall' esperienza acquisita dall'A. nella sua permanenza nell'Africa Orientale.

SUMARIO

El autor discute la patologia, sintomatologia, diagnostico y tratamiento quirurjico de la elefantiasis tropical y presenta su tecnica operatoria, que el desarroyo durante su servicio militar en el occidente de africa.

SOMMAIRE

L'apparence clinique, l'image pathologique et le traitement chirurgical de l'éléphantiasis, surtout du scrotum et du pénis sont discutés en détails ainsi que la technique chirurgicale élaborée et employée par l'auteur quand il était en service en l'Afrique Occidentale.

# A New Method of Portable Skeletal Traction for Compound Fracture of the Humerus*

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THE Italian scientist Codevilla (1903)[15, 16, 17, 18, 19, 20] originated skeletal traction. Driving a pin through the calcaneus, he stretched the limb and applied plaster to keep it in traction. For his times Codevilla achieved amazing results with this type of treatment. He treated successfully coxa vara with osteotomy and skeletal traction and also corrected shortenings of the leg up to 6 cm. resulting from malunited fractures. Later Steinmann (1907)[58] recommended permanent skeletal traction with a pin, applying no plaster bandages. This modified method of traction had even greater possibilities for functional treatment of fractures.

Skeletal traction underwent important technical improvements in later years. Klapp (1912)[43] introduced skeletal traction with soft wire ("Drahtextension"); Herzberg (1918)[35, 36] invented the bow to hold taut the wire, and Kirschner (1927)[42] used the bore wire ("Bohrdraht"), which was passed through the bone either by hand or by an electrically-driven instrument and remained there, serving as a traction.

In accordance with the aforementioned achievements with skeletal traction and traction of the humerus, applied at first by means of a pin (Codevilla-Steinmann), followed by a soft wire (Klapp) and since 1927 Kirschner wire has been mainly used. The proposal of Florschütz[25] and, later, that of Boever[10] to pass a metal screw into the ulna or the olecranon did not attain popularity. In the long list of authors who merit popularization for analysis of the indications and technical improvement of humeral skeletal traction, the following scientists should be mentioned: Florschütz,[25] Henes,[37] Ansinn,[1, 2, 3] Steinmann,[58, 59, 60] Block,[8] Stahnke,[56, 57] Baumann,[4, 5, 6] Groves,[30] Kappis,[33, 40] Klapp u. Block,[44] Hoke-Thornton,[61] Putti,[53] Johner,[38] Domrich,[22] Gilereest,[28] Faltin,[23] Boever,[10] Boeminghaus,[9] Fölsch,[26] Valls-Girardi,[62] Leveuf-Girode-Monod,[48] Zachumenszky,[64] Patterson,[51] Deuticke,[21] Okamura,[50] Caldwell-Smith,[12] Haggart-Bailey,[34] Piotet,[52] Machado,[43] Kyrle-Popovic,[47] Christie,[14] Köstler,[46] Godard,[29] Boitchev,[11] Key-Conwell,[41] Fitts,[24] etc.

The Kirschner wire, with hardly any exception, today is used for skeletal traction of the humerus. It is most easily driven by means of an electromotor, a local anesthetic having been applied. The wire can be passed through the distal end of the humerus (diacondylar), through the olecranon or through the proximal end of the ulna. The diacondylar approach is considerably hindered by hematoma and swelling in the region of the elbow. Its application is also limited because of the danger associated with injury of the ulnar nerve. Traction through the olecranon is inconvenient because of the proximity of the elbow joint. Besides, the wire might easily cut the narrow stripe situated between the joint and the bursa olecrani. Therefore the most suitable spot remains the posterior edge of the ulna, under the elbow joint. It is easily reached and is thick enough not to be cut off by the wire during traction.

Infection of the wire track may be prevented by Beck's[7] metallic pads and screws, which keep the wire in a fixed position and prevent its sliding down the bone canal.

Skeletal traction of the humerus may be applied in two ways:

1. By traction appliances fastened to the bed (Ansinn,[2] Baumann,[5] Klapp u. Block,[41] Putti,[53] Gilereest,[28] Boeminghaus,[9] Patterson,[51] Caldwell-Smith,[12] Haggart-Bailey,[34] Machado,[49] Christie,[14] Godard,[29] Key-Conwell[41]).

2. By abduction splints and frames fastened to the thorax (Florschütz,[25] Henes,[37] Stahnke,[57] Faltin,[23] Valls-Girardi,[62] Zachumenszky,[64] Kyrle-Popovic[47]).

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I. Traction in bed can be applied by different positions of the arm: (1) abduction of the arm, usually at 90°, at a right angle and half pronation of the forearm; (2) vertical position of the arm obtained by suspending the forearm; or (3) traction by means of splints fastened to the arm, e.g., the modified Thomas splint, Block's[8, 44] traction apparatus, etc.

Traction of the humerus in bed is accompanied by many inconveniences. First of all, the patient has to be kept immobile in bed. This forced position is a torment to younger patients when no other heavy bodily injuries are present, and for older persons there is always the danger of hypostatic pneumonia and decubitus. The fractured bone is not fully immobilized, for the movements of body and limb affect the fragments of the fracture. Thus the fracture is deprived of the immobilization so necessary at the beginning for the complex biological process of union. The continuous displacement of fragments causes pain, nervousness, lack of sleep and loss of appetite, all of which prevent speedy repair of the fracture. Side displacements of the fragments are not rare. Gilcreest[28] and Köstler[46] try to immobilize the body with the help of plaster casts which are made for each patient separately, before applying the traction.

II. Skeletal traction of the humerus can be applied by means of splints and apparatuses fastened to the thorax. Thus the traction becomes portable and the patient is not forced to lie in bed. Every abduction splint can be adapted for this purpose. Christen[13] wooden abduction splint with a weight freely hanging (see Klapp and Block, page 238) gives the primary image of portable traction of the humerus. Abduction apparatuses made of light metal, which make possible all movements of the shoulder and elbow joints, represent a more perfect portable means of traction of arm. (Frank,[27] Woloschinow,[63] Borchard-Stahnke,[56, 57] König-Lamberger,[45] Goddard[29] and others). One of the advantages of these abduction frames, as has been strongly emphasized, is avoidance of the fixing plaster cast (i.e., the spica humeri plaster cast) and the securing of mobility of the joints by easy changes in the position of the limb (i.e., major or minor abduction, anteposition, rotation of the arm). The frame is attached to the thorax by means of belts. Consequently, in contrast to the spica humeri plaster cast, it leaves body and limb free and revealed.

The weak point of every abduction frame, however, lies in the fact that its attachment to the body can never be perfect. The frame can move sideways and slide down, especially during the night's rest; thus the fragments are displaced and the fracture looses the necessary immobilization. The mobility of the frame and its daily replacement in the correct position makes treatment of the fracture painful and ineffective. The incomplete immobilization has especially harmful effects on compound and infected fractures of the humerus.

The abduction frame can naturally be attached to the thorax by means of a plaster bandage. This considerably increases its stability. Florschütz[25] and Henes[37] proceed in this way. They attach abduction frames previously prepared of wire splints (Cramer) to the thorax and connect the traction string (which is passing through a pulley) with a rubber tube fastened to the lower end of the frame. Some surgeons attach bow-like wire Cramer splints to a spica plaster around the elbow and tie the string of the skeletal traction apparatus to these. It is obvious that these wire splints and frames can not withstand the pulling and the skeletal traction can never be rightly adjusted. Hard and stable traction appliances should be attached to the plaster. For example, Hoke[61, 41] uses a metal bow provided with a special screw, which he incases along the arm. Thus a traction of definite force is possible. I supply the spica humeri plaster cast with a wooden or metal appliance for skeletal traction. It is attached to the lower part of the arm, so that the whole upper half of the plaster sleeve can be removed without affecting the traction or the full immobilization of the fracture. As will be shown later, by means of this device the skeletal traction can be precisely adjusted by means of a spring scale and a screw.

The indications for skeletal traction of the humerus are not exactly determined, nor are they clearly distinguished from those for other methods of treatment, i.e. indirect traction (adhesive strips), plaster of Paris bandages,

etc. Some authors apply skeletal traction only in extremely rare cases, while others use it routinely for certain kinds of fractures of the humerus. Skeletal traction is most often employed for fractures of the distal end of the humerus fractura supracondylica, fracturae t-v-y extraemitatis inferioris humeri (Florschütz,[25] Henes,[37] Kappis,[40] Groves,[30] Baumann,[4, 5, 6] Putti,[53] Boeminghaus,[9] Fölsch,[26] Patterson,[51] Leveuf-Girode-Monod,[48] Deuticke,[21] Okamura,[50] Piotet,[52] Kyrle-Popovic,[47] Christie,[14] Key-Conwell[41]). A great many surgeons, however, employ skeletal traction for fractures at the proximal end and the shaft of the humerus (Stahnke,[56, 57] Ansinn,[2, 3] Thornton-Hoke,[61] Domrich,[22] Gilcreest,[28] Faltin,[23] Valls-Girardi,[62] Caldwell-Smith,[12] Haggart-Bailey,[34] Manchado,[43] the author,[32] etc.

In my opinion, skeletal traction of the humerus should be applied as follows:

1. For fractures of the distal end of the humerus when reduction by manipulation of the fragments followed by a plaster bandage proves unsuccessful. In such cases, before operative treatment is undertaken, skeletal traction of the proximal end of the ulna should be tried; for, as a matter of fact, such traction often gives excellent results in a few days—a good reduction, and retention of the right position of the fragments. The operation that seemed unavoidable becomes unnecessary. In such a case indirect traction with adhesive strips is ineffective, because the distal fragments of the fracture are very short and reduction is accomplished only with difficulty.

2. For highly displaced and badly comminuted fractures at the proximal end of the humerus when the necessity for strong skeletal traction appears. Failure to reduce the fracture with indirect traction is often followed by a full success after Kirschner's wire has been applied.

3. For oblique or comminuted fractures of the shaft when indirect traction cannot be applied because of eczema, dermatitis, folliculitis, etc.

4. For all displaced and inveterate fractures of the humerus, when the strong adherences allow reduction of the fragments only by means of very strong skeletal traction.

5. For all compound and infected fractures of the humerus which are favorable to the application of skeletal traction. Large wounds of the humerus make the use of indirect traction impossible. Besides, the copious secretion is apt to remove the adhesive strips. On the other hand, the spica humeri plaster cast immobilizes the fracture but does not keep the fragments in the right position. Soon after application of the plaster cast the size of the arm diminishes considerably as a result of the resorption of hematoma and the subsidence of the swelling. The plaster cast becomes very loose, and the fracture is again displaced. A second forced reduction, together with a change of the plaster cast, is however, absolutely not indicated. Every disturbance of the immobilization of the limb, especially a rough reduction of the fragments, inflames the infection and causes a series of uncalled-for and dangerous complications. Therefore, skeletal traction is most favorable for a successful treatment of such fractures of the humerus: it reduces the fragments slowly and sparingly; it keeps them in the right position up to the day of their union, and it makes possible observation of the arm (gasoedem) and regular dressing of the wounds.

It must be admitted that in spite of all the aforementioned merits, skeletal traction has failed to find a widespread application in the treatment of compound and infected fractures of the humerus, because it never secures the necessary immobilization of the limb. I have underlined its principal defect; neither by traction in bed nor by traction with the abduction apparatus can the fracture be well immobilized, and it is well known that for compound and infected fractures the most important factor in success is full immobilization. Indeed, this is the foundation on which every method of treatment should be based. Imperfect immobilization of a compound fracture facilitates the spreading of infection in the bone and in the soft parts, thus prolonging the treatment. It is of great importance, therefore, that skeletal traction of the humerus be combined with an immobilizing plaster of paris cast. I have been doing this for some years by means of traction appliances attached to the spica humeri plaster cast.

My method is based on the principle of the traction plaster cast (Codivilla, 1903)

and is carried out as follows: 1. Pass a Kirschner wire through the ulna by means of the electromotor, with local anesthesia. Stretch the wire and fix it after the fashion of Beck's[7] bow. 2. Slow traction of the bow at abduction 70° and anteposition 30° of the arm, stretching to 135° of the forearm. Reduction of the fragments is gradual and sparing (in cases of compound fractures, excision of the wound, etc., should be done). Then apply the spica humeri plaster. The proximal part of the ulna remains open at the point where traction is applied and the wounds are revealed by wide plaster windows). 3. The portable wooden (Fig. 1) or metal (Figs. 2, 3) traction apparatus is incorporated with the arm part of the spica humeri plaster cast, and the traction string is attached to it.

Portable traction apparatuses are of the following kinds:

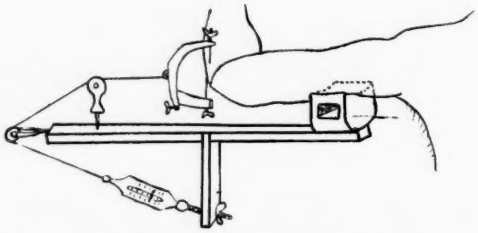

Fig. 1. Wooden portable traction apparatus for fractures of the humerus, which is very light, cheap and can be prepared by any carpenter.

1. A wooden apparatus (Fig. 1) consisting of a level lath, 50x2x1.5 cm., with a wooden rectangular piece nailed on its upper proximal end, 10 cm. long, 6 cm. high and 5 to 6 cm. wide. A hole runs through the middle of this wooden piece, through which the fixing plaster bandage passes. Its upper side is carved to suit the round shape of the arm. Downward from the middle of the level lath runs a second, perpendicular lath, 10x2x 1.5 cm. At this lower end a hole runs across for the traction screw. Two pulleys are screwed up at the distal end of the level lath. Through them runs the traction string, which is attached to the spring scale, and the latter in its turn is tied to the traction screw. The traction screw is operated by means of a two-winged female screw, and traction on the humerus is measured on the spring scale. The apparatus is both light and cheap and can be made by any carpenter.

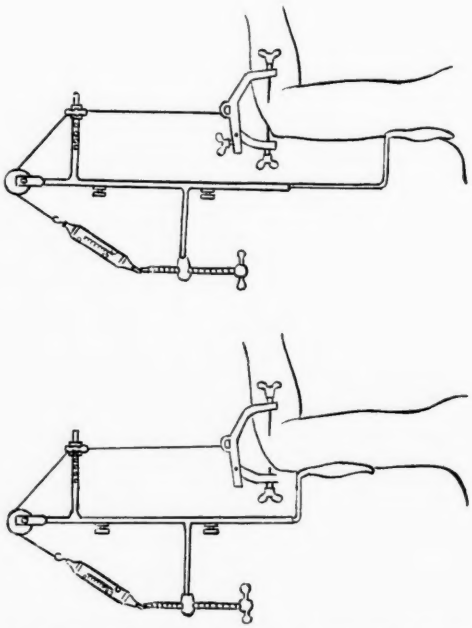

Fig. 2, 3. A light portable traction apparatus which can be lengthened by 10 cm. This way the shovel of the apparatus can be incorporated in plaster as high up as the arm pit (Fig. 5) or forward to the elbow (Fig. 4) according to the position of the wounds.

2. A light metal apparatus (Figs. 2, 3). Its shape resembles that of the wooden one. It consists of a thin metal tube 40 cm. long, with a metal stick fixed to it by means of two screws. This metal stick breaks at a right angle and continues 10 cm. upward, ending in a shovel 8 cm. long and 4 cm. wide. The latter is used to attach the apparatus to the spica humeri plaster cast. The metal stick is made movable so that the apparatus can be lengthened by 10 cm. (Fig. 4). In such a case the shovel can be incorporated in the plaster, if necessary, as high as the armpit (when windows are to be cut through the distal part of the plaster sleeve). The metal stick ends in a pulley. Over the metal tube near

its proximal end a hollow stick points upward, with a metal ring around it, through which the traction string runs. The ring is fixed at the necessary height by means of a screw. From the middle of the tube a short metal stick 10 cm. long runs downward with a metal screw connected with the spring scale. By means of the traction screw the skeletal traction can be very precisely adjusted. The force of the traction is usually 5 to 6 Kg.

What are the advantages of this portable traction plaster apparatus?

1. The spica humeri plaster cast and the skeletal traction secure full immobilization of the fracture. The fragments cannot be displaced even after dispersal of the hematoma and the swelling, since these are continually under the influence of the traction.

2. For inveterate infected fractures a slow and sparing reduction of the fragments can be accomplished by a gradually increasing skeletal traction continuing for some days. Thus a good reduction of the fracture is achieved (which cannot be obtained by any other kind of treatment) without provoking the inflammation process. In such cases, in order that the forearm may be moved forward at the time of the traction, it should be left free from the very beginning by cutting the upper half of the plaster from the elbow to the fingers.

3. The traction is portable. The patient is not obliged to lie immobile in bed. If necessary, discharge from the hospital is easy and speedy.

4. If there is danger of gas edema, the whole upper half of the plaster sleeve can be temporarily removed. Thus the arm can always be observed without interfering with skeletal traction or immobilization of the fracture. When the danger is over the plaster cover can be fixed again in its place.

5. For compound fractures of the humerus it is quite easy to cut wide plaster windows on any side of the plaster sleeve so that the wounds can be treated and observed. The shovel of the metal traction apparatus takes little room and can be incorporated either backward to the armpit or forward to the elbow, according to the position of the wound.

6. In comminuted fractures of the shaft of the humerus, a luxuriant callus is never formed to compress and irritate the radial nerve, because the skeletal traction reduces the fragments in a correct position, while the spica humeri plaster cast removes the possibility of new dislocations, which often cause a surplus formation of callus. When the comminuted fracture is compound and infected, I increase the skeletal traction above the set standard (4 to 6 Kg.) but only for the first few days. Then the fragments are set apart at a microscopic distance, and the pus pours out more easily (mechanical microdrainage). Thus a considerable hindrance, the result of dense and disorderly piling up of bone fragments, is removed. The mechanical drainage lasts only for a few days, until the pus secre-

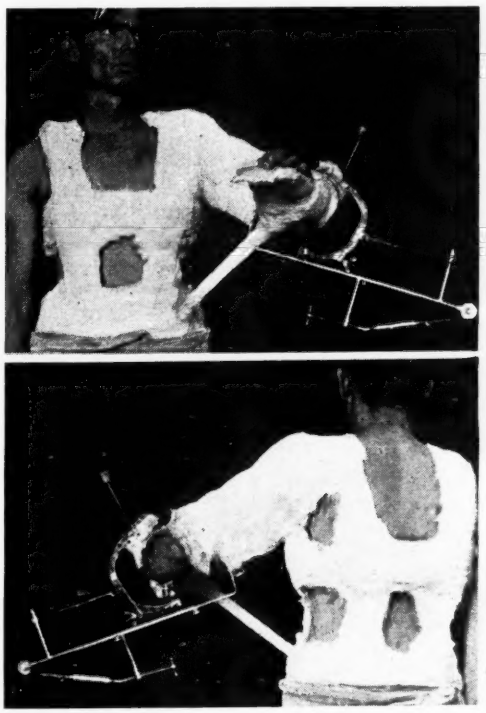

Fig. 4, 5. Here the metal portable traction apparatus is attached to the spica humeri plaster cast (made of six slabs, according to the author's method). It is light, cheap, and can be applied in 10 to 15 minutes. The numerous plaster windows facilitate ventilation and neatness of the body and make observation of the thorax possible. If necessary the windows can be broadened.

tion lessens and the septic temperature curve comes down to normal. It has no harmful consequences, for immediately after the decrease of traction the bone fragments come together (contraction of the muscles).

7. Early movements of the joints are possible. From the very beginning the upper half of the plaster in the region of the hand is cut so that the hand remains free to move. Later (10 to 30 days, according to the case) the forearm and the elbow joint are freed in the same way. The skeletal traction does not hinder the pronation and supination of the forearm, nor does it interfere with the moderate flexion and extension of the elbow joint. The remaining upper half of the plaster sleeve around the arm and shoulder is taken away after the skeletal traction is removed. Thus the spica humeri plaster cast becomes an ordinary abduction apparatus, allowing all possible movements in the joints of the upper limb. The plaster is removed when the patient begins to raise the limb freely.

I have modified the technic of the spica humeri plaster cast lately; I make it of only six plaster slabs. In this way it becomes light and cheap and requires only 10 to 15 minutes to make. The numerous plaster windows facilitate ventilation and neatness of the body, and also make it possible to examine the thorax by auscultation and percussion. They also permit some other treatments (cupping glass camphor oil, etc.).

I was able to apply the afore-described method to seven fractures of the humerus, of which six were compound and infected. The results were always completely satisfactory: a good reduction of the fragments, a quick abating of the infection due to perfect immobilization, and normal union of the bone, together with excellent functional results.

I shall describe briefly two of these cases, in one of which a wooden apparatus and in the other a metal apparatus was used.

*Case 1:* The patient came to the clinic in a septic state on the third day after injury, with an infected war wound fracture of the humerus. The arm showed two war wounds: a circular wound 1 cm. in diameter over the deltoid muscle (near the tuberositas deltoidea), and an irregular wound as large as a palm with torn edges in the middle third of the arm. Thick, luxuriant, yellow-greenish pus was pouring from both wounds. The roentgenogram revealed comminuted fracture of the humerus involving almost the whole shaft. Soon after the spica humeri plaster cast and the wooden portable traction apparatus were applied with 8 Kg. of traction, the temperature curve came down to normal and the enormous swelling of the arm decreased. The pus also diminished, becoming slimy. On the seventh day, skeletal traction was reduced to 5 Kg. The wounds were dressed through two wide plaster windows. The war wounds were fully healed in 45 days.

Movements of the wrist began on the fifth day, immediately after the septic state had passed. On the 25th day the patient began flexion and extension of the elbow joint and also pronation and supination of the forearm. For this purpose the upper half of the plaster sleeve in the region of the forearm was cut. On the 35th day the whole upper limb was set free by cutting the upper half of the plaster in the region of the humerus and shoulder, and the patient started active movements of the shoulder joint. In eight weeks he acquired normal movements in all joints of the limb. He left the clinic with a normal union of the fracture. In spite of the fact that the humeral fracture was highly infected and badly comminuted, the whole treatment took only about three months. There were no complications.

*Case 2:* The patient entered the clinic on the second day after injury, with a comminuted and infected fracture of the humerus. There were swelling of the arm, cold shivers and a septic temperature. Pus was gathering in the wounds. I enlarged and cleaned the wounds operatively, without desequestration, and applied the spica humeri plaster cast with a metal portable traction apparatus (traction, of 8 Kg.). Shortly afterward the pus diminished and the swelling abated. The skeletal traction was reduced to 6 Kg. At the end of the third week movements of the elbow joint started. The patient left the clinic after three and a half months' treatment, with normal mobility of the joints and a perfect union of the bone.

Both patients were treated (the first in

1943 and the second early in 1946) without sulfonamides or penicillin. In Hungary during World War II (we then used primitive wooden portable traction apparatuses made on the very spot Figs. 35-37) we gave great doses of sulfonamides in cases of infected fractures, later applying a combined general and local sulfonamide-penicillin treatment. Naturally the results, as far as the wound infection was concerned, were improved.

SUMMARY

After a short historical survey and a description of various methods for skeletal traction of the arm, the author describes various types of humeral fractures that are suitable for such treatment. He then describes his own method, which combines Slabs's spica humeri plaster cast with a portable traction apparatus made either of wood or of light metal.

SOMMAIRE

Aprés une courte revué historique et la description des différentes manières de l'extension directe du bras, l'auteur expose en 5 points les différentes fractures de l'humérus, qui convient pour un pareil traitment. Suit la description de la Méthode indiquée par lui pour l'extension directe de l'humérus, qui consiste en l'application d'un plâtre thoracobrachial fourni d'un appareil portatif d'extension fais en bois ou en métal léger.

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# Pituitary Transplantation from Cadaver in Treatment of Simmonds' Disease

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OF all the endocrine glands, the pituitary is most closely correlated with the nervous system. Numerous impulses are directed to the pituitary or proceed from it in the opposite direction. The literature dealing with this problem is constantly furnishing new data; therefore a short summary of recent knowledge should be given. The object of this paper is to present an operative procedure for pituitary transplantation, which is apt to involve nerve fibers of secretory function at the implantation site.

The new approach is based on the facts cited. Its purpose is to implant the gland into an environment belonging to the same sympathetic segment. Old methods dealing with implantation to the subcutis, to the muscular layer of the abdomen or to the omentum have been discarded. These methods may have been appropriate in the epoch heteroplastic transplantation, when the gland of a calf was used, but for homoplastic transplantation of the gland of a cadaver a new biologic approach seems more promising.

Experiments based on this idea have been done by J. Szentagotai on rats. These experiments have led to very interesting results:

*Free Homotransplantation of Rat Pituitary into the Cervical Musculature:* Near the transplant, the superior cervical sympathetic ganglion or its severed postganglionic fibers, having remained in contact with the ganglion, was fixed.

*Result After a Fortnight:* At one place in the preparation a piece of the pituitary measuring 1 mm. in diameter was seen. Specific pituitary tissue was hardly visible. Starting from the nerve stump, numerous thin fibers of the sympathetic type entered the transplant, especially along the vessels.

Thus, in a case in which the preganglionic fibers of the sympathetic ganglion were left intact, the postganglionic fibers entered the transplant. (The preparations were impregnated by the method of Gross.) These experiments supported my intention and induced me to perform the operation in such a way that the pituitary, cut into lobules after its removal from the cranial base of a cadaver, was implanted between the sympathetic fibers of the internal carotid artery.

The fact that homotransplantation is the method most likely to result in success was first emphasized by Eiselsberg. He was also the first to implant the epithelial bodies of a human being, dead of an accident, into a patient suffering with tetany (1908).

It is an ancient problem whether certain organs of persons dying suddenly may not be employed for transplantation on a wider scale. It was necessary to keep this procedure within legal limits; I therefore sought the agreement of legal authorities as to the conditions under which the operation was performed.

The procedure is called a sterile dissection and takes place in two stages. In the first stage, performed by surgeons in the operating room, the presence of a pathologist or a medicolegal expert is necessary in order that the status of the cranial cavity may be observed and described; thus the first stage of dissection takes place two hours after death in the operating room, the second in the usual way in the dissection room. Sterile dissection was performed only when it could be stated by the police that postmortem examination would be mandatory in any event. The two hours elapsing between death and sterile dissection was enough for the arrival of the pathologist and for transportation of the patient from the ward. One assistant removed the pituitary from the cadaver according to the usual technic of exposing the brain at dissection, while on the other operating table the carotid artery of the patient was liberated so that the gland might be implanted within a few minutes.

Neither the cadaver nor the postmortem examination suffered any harm by this abbreviation of the legal interval (six hours) between death and dissection.

The patients treated by pituitary transplantation form two groups. The first group, treated with the human gland only, contained one patient, a woman 41 years old. She had been examined by Prof. B. Horanyi. Three patients, a 17-year-old girl and two 19-year-old girls, had been examined by Dr. Petanyi, Dr. Volgyesi and Dr. Richter respectively. These patients, who formed the second group, had been treated previously by transplantation of calf pituitary as described by Kylin.

Without exception, all patients with Simmonds' disease had been observed and treated by skilled practitioners over a long period and were referred to us only after serious consideration. In each case we gave the parents all necessary information as to the operation and its occasional dangers. Each patient's address and telephone number were taken, so that they could be called when a suitable cadaver was immediately available. The patients were cooperative, awaiting our notice with interest.

In choosing a pituitary for transplantation, much care was taken. Eppinger's postulate that only a woman's gland should be implanted into a woman was carefully observed; also, as we were dealing with girls from 17 to 20 years of age, we made a point of securing, in each case, the pituitary of a dead woman of similar age.

Our hospital is situated in the center of the city and has the character of an emergency ward. About 20 patients per year, admitted for accidental injury, do not survive the day of admission. The moment a death occurred, one of our patients suffering from Simmonds' disease and corresponding in sex and age to the dead patient was called by telephone. In this way we performed a total of seven transplantations, four of which were done for Simmonds' disease.

The fact that primary healing of the cervical wound was observed in all cases is a proof that the pituitary gland was removed by a really sterile dissection. All patients were able to leave their beds by the third postoperative day.

Once more the question may be raised as to the advantage of implantation into the carotid sheath as compared with the old method of implantation into the abdominal subcutis or muscle. In considering this question, it must be remembered that the basic principles of the two operations are not the same. Implantation into the abdomen is directed toward securing an abundant blood supply for the transplant, whereas implantation into the carotid sheath aims at a proper site from the viewpoint of nerve supply. This site should be anatomically not far remote from the original site of the pituitary; therefore, since animal experiments have shown that the carotid sheath and the pituitary belong to the same sympathetic segment, there is a possibility that sympathetic fibers (occasionally secretory fibers) may grow into the substance of the transplanted gland.

All transplantation studies performed to date indicate that no transplant whatever can remain in the organism for a long time in a state of functional ability. Nevertheless, we hope that this method of homotransplantation will result in prolongation of the life of the transplant. This seems not unlikely, provided that, in addition to the abundant blood supply, the innervation of some pituitary lobules has been secured.

As to the final results of any treatment, the most objective criticism is that of time. Time will show whether transplantation of a human pituitary can yield a more valuable graft than the gland of a calf as suggested by Kylin, and whether implanting the gland into the carotid sheath can bring about more favorable conditions than are obtained by the abdominal subcutical transplantation.

## SUMMARY

Pituitary transplantation can be performed in two hours after the donor's death without any difficulty. Wound healing has ensued in seven instances without any untoward events. All patients suffering from Simmonds' disease responded favorably to the operation. The increase of body weight, varying from 16 to 22 Kg., has lasted at least for three to seven years. For patients previously treated by Kylin's operation without success, the operation described in this paper has had good results.

Two patients after seven years and two patients after three years of observation are free of all symptoms, the increase in body weight ranging from 16 to 24 Kg. Two patients after 1½ years have died of pulmonary tuberculosis.

# Harelip—A New Surgical Technic

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BRUSSELS, BELGIUM

ARTISTIC as well as surgical anatomy is of the highest importance. By operation, in many cases, we are endeavoring to give the patient features that closely approach those of the normal countenance.

When we consider the problem of harelip as a whole, and especially if we analyze the bad results obtained all too frequently by poorly controlled technic, we are forced to admit that the harm done by the labial anomaly does not stop at the lip, but extends to and includes the base of the ala of the nose, not to speak of the fairly frequent occurrence of palatine complications. It is not exaggeration, therefore, to speak of a surgical trilogy in this connection: nose, lip and palate.

Since operation for harelip is a matter of moulding a mass, it is absolutely necessary to study not only the plane dimensions, height and width, but the third dimension, thickness, which is too seldom mentioned or considered In other words, it is not sufficient to restore the lip and the nostril as viewed full face; one must also study them from the point of view of profile.

With regard to the front view, the following points are listed in the order of their importance:

1. The philtrum, which marks the center of the lip.
2. The two columellae, at the level of which it is desirable to place the sutures.
3. The lower surfaces of the nostrils, which should be as well filled out on the operative side as on the normal.
4. The alae, the bases of which should be restored symmetrically.
5. The nasal orifices, the contours of which should be of equal length and of normal oval form.

When studying the profile, particular importance should be attached to:

1. The prominence of the upper lip. Especially to be avoided are the frightful retractions that are characteristic of an unsuccessful operation, for these mark the subject for life. A temporary hypercorrection should also be made to prevent the lower lip from jutting out abnormally from the profile at a later date.

2. The concavity of the labial profile. Only by means of concave, curvilinear cutaneous lines can the edges of the skin be so drawn together as to assure the proper outline and the natural grace of the lip.

## TECHNIC

From the time I first began to use my technic, which was conceived in 1937, I have obtained excellent results. Although from time to time I have tried standard methods, I invariably returned to my personal technic, because it gave better results.

*Line of Incision:* This line is curvilinear on the internal side and slightly curved on the external side. The incision continues cleanly into the pink edge without the necessity of cutting a flap.

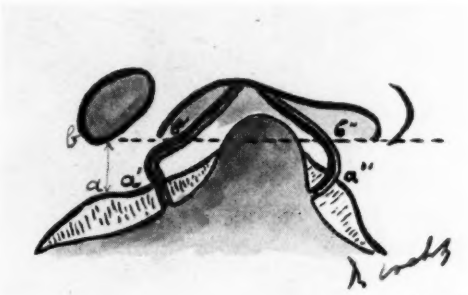

Fig. 1. Line of incision.

*Suture of the Lining:* The lining can be made not only from the mucous membrane but from the skin of the edges.

*Treatment of the Base of the Ala:* The base of the ala will be detached at its deepest part, i.e., under the muscle. There will therefore be no cutaneous incision.

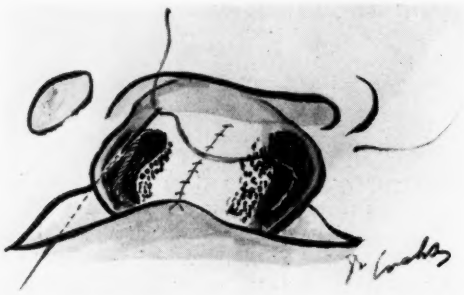

Fig. 2. Exo-endobuccal muscular suture.

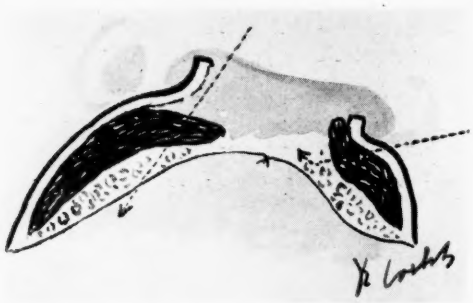

Fig. 3. The U stitch traversing muscles.

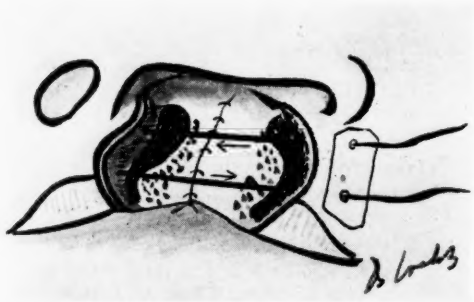

Fig. 4. Securing of the "latch."

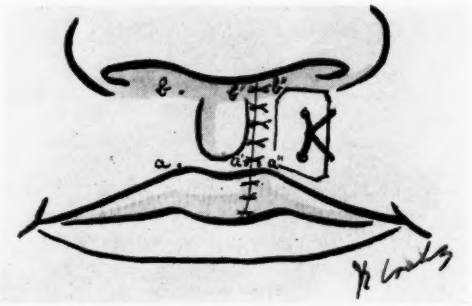

Fig. 5. The end of a single operation.

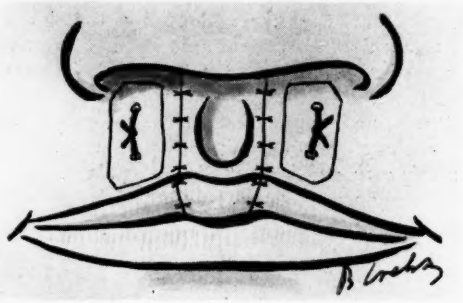

Fig. 6. The end of a double operation.

*Exo-endobuccal Muscular Suture:* It is known that neither of the two flaps is sufficient in itself to reestablish the relief; together, however, they restore perfectly the plane of the lip. An exo-endobuccal stitch is begun at the external side surface, traversing skin and muscle on that side and then, on the internal side, traversing muscular, glandular and mucous layers to come back to the skin's surface six or seven mm. lower down.

*Securing of the Latch":* The two muscular surfaces, thus prepared, drop one on the other in the manner of a latch. This enables the edges of the skin to be approximated without difficulty. The V stitch will hold the muscular fibers crosswise, something like a rider.

*Skin Suture:* Suture of the skin is easily performed by means of very small stitches, for no resistance has to be overcome.

The double harelip operation is done in the same way, in one stage. The skin of the median tissue acts as philtrum, and the two sutures are placed where the two columellae should be.

*Postoperative Attention:* Two-thirds of the fine stitches can be removed from the cutaneous surface on the third day and the remaining third on the fifth day. The U stitch is taken out on the fifteenth day.

*Advantages:* The advantages of this method

are: (1) to date, in more than 250 cases in which operation was done by this method, I have had no case of disunion; (2) the proper relief of the upper lip is assured; and (3) restoration of the philtrum and the columellae disguises the vertical sutures.

Fig. 7a. Before. Fig. 7b. After.

A result of the author's technic.

Fig. 8a. Before. Fig. 8b. After.

A result of the author's technic.

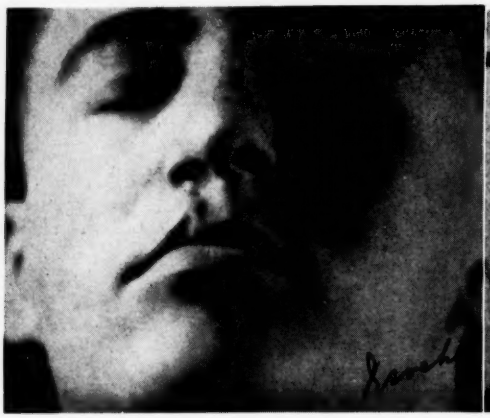

Fig. 9a. Result of an unsuccessful technic.

Fig. 9b. Correction of Fig. 9 by applying author's technic.

SUMMARY

The author's method of operation for harelip is described. The method is highly adaptable and can be applied in any case. It is also sure, for it obviates postoperative disunion. It gives morphologic and cosmetic results that restore the normal anatomic structures as nearly as possible.

RIASSUNTO

Il metodo illustrato dall'A. puo' essere applicato ad ogni caso. E' sicuro poiche' evita ogni possibile disunione dopo l'operazione, mentre offre risultati morfologici che ripristinano al massimo l'anatomia normale.

SUMARIO

El metodo del autor, descrito en este articulo, es sintetico en el sentido de que es aplicable a cualquier caso. Es un metodo seguro, por cuando previene la deshision post-operatoria, y da resultados morfologicos excelentes, pues permite la restoracion anatomica, lo mas exactamente posible, segun el caso.

SOMMAIRE

La méthode de l'auteur est synthetique dans le sens qu'elle est applicable à tous les cas. Elle est sûre car elle garantit contre la desunion postopératoire et elle donne des résultats morphologiques caractérisés par la restauration aussi exacte que possible de l'anatomie normale.

# *Editorials*

## Potent Medicine

Just how potent is medicine today? In other words, how strong a bulwark is the medical profession prepared to erect against unjustifiable and tyrannical interference by governmental authority with the immemorial relation between physician and patient?

In the October 1949 issue of the Journal of the *Oklahoma State Medical Association* there appeared an editorial entitled "Liberty or Death," containing these lines: "Our freedom is based upon the gift of reason . . . It is a God-given freedom with no controls except the exercise of conscience, and any plan for the people's health not based upon the judgment of physicians is an insult to human intelligence. . . . Mr. Ewing's prescription for the health of the nation is as naively presumptuous as Mother Eddy's obsession that she came to complete the unfinished mission of Jesus Christ."

The disastrous experience of Britain with socialized medicine sounds a timely warning. Mr. A. Lawrence Abel of London, speaking before a recent meeting of the American Proctologic Society, said things that ought to bring American discussion up to a round turn. The American habit—basically a good one—of listening to every man's opinion, and giving it at least the benefit of any doubt attached thereto, can perhaps be carried too far when vital issues are involved. Too much of the propaganda for socialized medicine here originates in the enthusiastic but uninformed minds of those who have, to speak plainly, no actual realization whatever of the definite problems involved.

The general lay public in any country is easily gulled. Mr. Abel, in his well-documented indictment of the system in England, admits freely that "the people love it;" but, he points out, they love it because it makes medical aid available "free gratis for nothing," and have not the faintest realization that it accounts for a great part of the crushing tax burden they bear. Servant girls have been known to apply for—and get—as many as a dozen pairs of spectacles, on the theory that it is foolish not to get as much as you can of anything you don't have to pay for. "The demand for teeth, hearing aids, wigs, brassieres and spectacles," says Mr. Abel wryly, "has exceeded the expectations even of those who thought they understood human nature." People cross the Channel from France and other countries to get free appliances, free spectacles, free radiotherapy, etc., in order to avoid paying for these at home; in the first nine months of the system's operation the cost for service to non-British applicants was approximately one million dollars.

This sounds fantastic, if not actually comic; but there is a substructure of tragedy beneath it. As Mr. Abel justly points out, "the apparent material benefits cloak the real loss of true medicine. . . . True medicine means early diagnosis and early and good treatment." Early and accurate diagnosis on an assembly-line basis is highly improbable, to say the least; and how can treatment be either early or good when the doctor is hampered at every turn by the overpowering load he must carry, the endless official forms he must fill out, and the constant frustrations involved in having to devote to political demands and adaptations the time and thought that belong to his profession?

The demoralizing effect of bureaucratic medicine on the general public is sufficiently demonstrated by the exploitations just described. There is plenty of good strong evidence throughout history that no man sets much value on what costs him nothing; and, although bureaucratic medicine costs him a good deal, the effect is the same if he is not aware of the cost. The national economy will also suffer in the final analysis. As for the medical profession itself, its dangers can hardly be exaggerated. The increased load of work, the ever-increasing tangle of red tape, and the regimentation (strongly reminiscent

of that necessary in time of war) might perhaps be borne; ours is a durable and much-enduring craft and has proved it times without number. But the damage to medicine itself and, above all, to the time-honored and infinitely valuable personal relation between the doctor and patient can be irreparable; it can mean the ultimate destruction of the art of healing as anything more than a political device.

Already, in Britain, the system imposes nearly insuperable obstacles in the way of a young doctor just going into practice; in some instances he must actually establish residence in a certain locality before he can make application for a post there! As a number of other applicants are sure to be involved, his chances of being compensated in any way for this appalling loss of time and money are small indeed.

The quality of medical care in both clinics and hospitals must decline as a result of the immense cost of "free" service. A ten percent cut in hospital costs was recently ordered by the British Ministry of Health; in one group of hospitals this meant cutting down the patients' food budget by $20,000 a year. As everybody has an equal right to benefits under the system, many sorely needed hospital beds are occupied for long periods by persons with chronic ailments who do not require hospitalization and could be treated quite as well at home.

The medical profession in America has been seriously criticized and blamed for its refusal to accept such regimentation for either doctors or patients; but with the concrete evidence before its eyes, surely the most idealistic agitation group must admit that its beautiful dream is a mirage at best. No man, and certainly no physician, denies that an ideal condition of society would require equal and excellent medical care for every man, woman and child in the world. But we are far from living in an ideal society. Patience, thought, and the slow but effective therapy of education will be needed to cure the world's chronic illness; with regard to radical operation our world must at present be regarded as an exceedingly poor risk. As Mr. Abel aptly points out, all great social changes must take place by evolution, not revolution, if they are to take place without destroying important segments of the social fabric. The concern of physicians about the threat of bureaucratic control has far less to do with personal prestige than the lay public imagines. Doctors are admittedly human and have human ambitions and desires, but there is not one worthy of his title who is not far more concerned about the welfare of his patients and the maintenance of high professional standards than he is about his own aggrandizement. There are too many points of similarity between a sick patient and a sick society to escape the doctor's trained and experienced eye.

Returning to the Oklahoma editorial, we quote: "Regardless of pressure groups and the popular opinion, God help us to say No. We may rest assured that once the bureaucratic rats find a hole they will crawl in, chew up the cheese and leave their offal in the cupboard." Strong language, no doubt. But so was the language of Patrick Henry when he cried, "I know not what course others may take; but as for me, give me liberty or give me death!" The potency of medicine is sometimes in direct proportion to its strength; and the potency of the medical profession in defending the faith of their pioneer fathers will be measured by the vigor and persistence of the fight it puts up against Federal invasion of sacred and inalienable rights.

It is to be borne in mind that the Abel report is one of many and that all tell the same story of ineptitude, inefficiency and exploitation. The American public will do well to think twice before subjecting itself to the chaotic conditions that would certainly result—conditions worse even than those reported from Britain, multiplied and complicated by our immense population and our diversity of culture, environment, income and tradition.

As for the individual citizen, who sometimes finds these national problems somewhat too large and vague to interest him, let him think of this problem in individual terms. Does he really want this thing called socialized medicine? When he is ill, does he want a form to fill out, or would he rather have a doctor at call to help him? If his child is hurt and must wait his turn for attention, will it comfort anyone that the attention is "free"?

M.T.

# Another Milestone

With its January 1950 issue the *Journal of the International College of Surgeons* becomes a monthly publication. Friends, readers and well-wishers all over the world have made this advancement possible. Publication of the Journal even on a bi-monthly basis has been more than rewarding, but recognition of its unique contribution as an authoritative periodical devoted not only to surgery but to the creation of world-wide understanding has made the change mandatory.

Contributions of increasing importance to the advancement of surgical science are arriving every day. The shift from a bi-monthly to a monthly basis will enable us to present these fine papers with the punctuality they deserve.

Events of high significance in the scientific and economic status of the world are constantly taking place. Each of them has its relation, often a vital one, to the problems and progress of surgery. From the day of the *Journal's* conception we have regarded it as an important part of our task to interpret the shifting world scene from the surgeon's point of view, to the end that surgeons, like all other good citizens of the world, may be stimulated to think in terms of international good will and permanent world peace. In addition to our regular editorial columns, the *Journal* now carries a department entitled *New Horizons*, presenting brief editorial comment on matters of international importance.

To our officers, members and subscribers, who cooperated so promptly and cordially in preliminary arrangements for a monthly Journal, we take this occasion to express our profound gratitude. To our colleagues all over the world, within the College and without it, every issue of the *Journal* is an invitation to share in the fellowship of scientific study on a world-wide basis.

There will be twice as many of those issues now—filled, we hope and believe, with more than twice as much value as ever before. The tonic effect of change, of quickened tempo, should stimulate staff and contributors alike to redoubled and highly effective efforts. Let us hope and resolve that the new milestone of 1950 will mark not only the realized dream of a monthly *Journal* but the beginning of a happy half-century of progress in both science and human relations.

M. T.

## Anesthesiology Essay Competition

The International College of Surgeons announces an award of $250 for the best essay on anesthesiology, to be presented by the Anglo-French Laboratories, Inc. The competition will be held on a world-wide basis and is not restricted to members of the medical profession.

All essays should be addressed to

Anesthesiology Essay Contest, International College of Surgeons
1516 Lake Shore Drive, Chicago

and postmarked not later than March 1, 1950.

# New Horizons

## By the Editor

### Consultation with Hippocrates

The celebration of Hippocrates Day on October 23 by the International College of Surgeons, with Dr. Skevos Zervos of Greece as the guest of honor at an afternoon reception and a grand banquet at the Blackstone, was an occasion to be remembered. Dr. Zervos, an internationally known authority in the life and work of Hippocrates, brought with him his outstanding collection of relics and art objects connected with the practice of medicine and surgery in ancient Greece. By proclamation of Mayor Kennelly, the entire week during which these treasures were on display at the College was set aside as Hippocrates Week. Distinguished physicians and surgeons from all over the world participated in the observance, which included the ceremonial planting of a shoot from a plane tree on the island of Cos, under which Hippocrates is said to have lectured his students; the acceptance and dedication of a statue of the ancient master, designed and presented by Dr. Zervos, and the unveiling of thirteen portraits of presidents and past presidents of the College.

Open house was held at the College throughout the week, affording many opportunities for fellowship and new stimuli to achievement. The occasion was typically cosmopolitan, conducted throughout in the spirit of international understanding and professional unity.

### Domus Chirurgica

It is with great pleasure and satisfaction that the International College of Surgeons announces the establishment of a new division of the Domus Medica in its Chicago home at 1516 Lake Shore Drive. This new division will be known as the Domus Chirurgica and is under the able direction of Dr. Valentin Charry.

We have long realized the need for a center to which surgeons may come freely at any time for information and guidance in such matters as reunions, conferences and important professional gatherings; for assistance in dealing with the problems of travel, and for postgraduate instruction and recommendation. It has been one of the many dreams of the International College in its plans for establishing a universal surgical fraternity, cooperative in interest and effort throughout the world, and its realization marks an epoch in the organization's progress.

Visiting students and doctors who are taking postgraduate courses will be welcomed to monthly meetings and conferences here. They will be given opportunities to inspect hospitals and research centers. They will be provided with a wealth of information about available cultural advantages of special interest to surgeons.

The travel service to be offered is founded on a thorough knowledge and a comprehensive idea of the traveling surgeon's needs, and will therefore include all possible data about the different nations of the world and what they have to offer in the way of historic interest, folklore and cultural advantages as well as their more definitely scientific aspects. Trips will be arranged in cooperation with established travel agencies. Members of the College will be provided with a booklet of credentials to carry with them, recommending them to the interest and friendship of colleagues and professional institutions in all quarters of the globe. Within a short time it will also be possible for members to obtain microfilm presentations of articles from the current surgical literature.

This is a good beginning, but it is by no means the end. The idea that underlies the

Domus Chirurgica is vital with a seed's vitality and may be counted on to grow. Already it seems probable that similar centers will eventually be established in most of the principal countries where chapters flourish. Another strong probability is that, as time goes on and the services already contemplated go into the effect, other services will suggest themselves as urgent and will be met. The lusty growth of the International College of Surgeons within a very short time is proof enough that the idea is dynamic and must ultimately prevail in all its manifold implications. At present, any organization based honestly on the desire for universal human welfare commends itself to this troubled and harassed world; when such an organization is based also on that most vital of human concerns, the preservation of human life, nothing can long impede its forward striving. In all humility we welcome and acknowledge the sympathetic attitude of the public and of surgeons in general toward the whole enterprise as conceived and carried out thus far, and we hope to make the Domus Chirurgica a fitting reciprocal gift to our brother surgeons.

## Words, Words, Words

It is cheering to hear from Dr. Walter C. Alvarez* of the Mayo Clinic a hearty and sensible echo of the sentiments expressed several months ago by Dr. Arnold S. Jackson† with regard to the urgent need for shortening and condensing medical articles submitted for publication. We are often reminded, not only on reading articles in manuscript but on reading much material actually published, of the little boy who was asked to review a juvenile book about penguins. "This book," wrote the truthful child, "tells me more about penguins than I care to know."

Both Dr. Jackson and Dr. Alvarez rightly condemn long-drawn-out introductions, unnecessarily detailed reviews of the literature (except in papers written specifically as reviews), the padding of articles with rehashed material from other authors' pages, and the endless piling of words upon words in a sentence that would be better constructed at half its length. Both point out that so many medical journals are now available that the busy physician or surgeon cannot possibly keep up with them all, and it is a great pity that his honest efforts to do so should be further impeded by torrent after torrent of useless verbiage. Moreover, the authors themselves would profit by condensation, because the time of waiting for publication would be immensely shortened. "Most medical and surgical journals," says Dr. Jackson, "have such a tremendous backlog of articles on hand that it will be months and perhaps years before some of these articles appear." Obviously, many articles lose their value if publication is too long suspended.

Old habits are hard to break, but they can be broken. We can think of no better aid to composition than Dr. Morris Fishbein's incomparable handbook Medical Writing‡, the second edition of which is now on the market. The reader will be entertained as well as instructed by some of the "horrible examples" in the chapter on style; e.g., "Medulloblastomas develop almost invariably in children taking their origin just over the fourth ventricle."

A little study of the basic principles of good writing would enable contributors to present their facts in compact, readable and significant form; to include what is necessary in the way of bibliographic references and allusions to the literature, and to leave out the rest. It is to be hoped that other distinguished voices will be added to those of Dr. Jackson and Dr. Alvarez, and that the resulting chorus will eventually drown out the frenetic stutter of typewriters "on the loose." That dread disease, cacoethes scribendi, has long been recognized as incurable, but the prognosis can be improved so far as interest and value are concerned.

*Proc. Staff Meet. Mayo Clin. 24:442 (Aug. 17) 1949.
†Am. J. Surg. 77:543 (May) 1949.

‡Philadelphia: The Blakiston Company, 1949.

# News Notes

## Dutch and Indonesian Tropical Medicine Journal Formulated

Recognizing that medical articles published in Dutch are intelligible to a comparatively small number of readers and that the mother tongue of Indonesia—the Bahasa Indonesia—is still more restricted, a foundation with headquarters in Amsterdam has launched a new quarterly journal of tropical medicine in English-Documenta Neerlandica et Indonesica de Morbis Tropicis, according to the *Lancet*. The editors of Documenta hope that much of the work done in Surinam and the Netherlands Antilles, as well as in Indonesia, will eventually be recorded in their journal. The annual subscription may be obtained from F.K.A.A. Lambrecht, 268, Rivierenlaan, Amsterdam Z, Netherlands.

## Chicago Cancer Research Hospital

The Nathan Goldblatt Memorial Hospital at the University of Chicago has begun construction as the first unit in the University's $8,500,000 Cancer Research Center. The building cost will amount to $2,075,000.

## Projects Allocated by the National Foundation for Infantile Paralysis

Funds allocated for research and educational projects by the National Foundation for Infantile Paralysis for 1949 now total $2,565,159, with additional grants to be made later in the year. The greater share of the funds will be devoted to research including one sum of $1,370,160 allotted for a three-year, coordinated effort at four universities to determine the number and characteristics of polio viruses which can produce human diseases. The four universities are: University of Southern California, University of Kansas, University of Utah, and the University of Pittsburgh.

## Connecticut Has First Hospital for Alcoholics

Construction of the first hospital in the United States devoted solely to the study, treatment and rehabilitation of alcoholics has been started in Hartford, Conn. Funds totaling $551,943 are available for this purpose and the new project will be under the direction of the Connecticut Commission on Alcoholism. The Commission will operate the building and organize and supervise its services. The new fireproof building will cost $423,500 and will be located on Coventry Street near the present McCook Memorial hospital. The Connecticut Commission on Alcoholism is headed by Dr. Selden H. Bacon, associate professor of sociology at Yale University.

## International Congress on Cancer

The fifth International Congress for Scientific Research and the Social Fight Against Cancer is to be held at the Sorbonne in Paris July 17-22, 1950. The Congress is open and those who wish to become affiliated with the union should address Prof. V. LeLorier, Secretary-General of the Congress, 6 Avenue Marceau, Paris 8, France.

## Journal Exchange

Arrangements have been completed for a regular exchange of journals between this office and that of the *Dutch Archives of Surgery*. This European journal, which will publish most of the articles in English, should provide a valuable link between surgical specialists in two continents.

## Inauguration of Brazilian Chapter

The inauguration of the Brazilian Chapter of the International College of Surgeons was held on the evening of September 30, 1949, in the auditorium of the Public Library in Sao Paulo, with Dr. Pedro Calmon, Dean of the University of Brazil, Rio de Janeiro, presiding. Prof. Carlos Gama, president of the new chapter, addressed the assembly.

## American Association of Blood Banks Has Second Annual Meeting

The second annual meeting of this organization was held at the Olympic Hotel, Seattle, Washington, Nov. 3-5, 1949. A varied program, covering both technical and administrative aspects of the work and implemented by exhibits, was present.

## The 16th International Congress of Ophthalmology

The 16th Congress of Ophthalmology will be held in London on July 17, 1950, Dr. Stewart Duke Elder presiding. The official languages of the Congress will be English, French, and Spanish. Two principal topics will be discussed: (a) the Sympathetic System in the Genesis of Vascular Hypertension and Its Effect on the Eye, (b) the Clinical and Social Aspects on Heredity in Ophthalmology.

Those interested in the Congress may contact Mr. Keith Lyle, Office of the International Congress of Ophthalmology, 45 Lincoln's Inn Fields, London, W. C. 2.

# New Books

**Operative Technic.** By Warren H. Cole. New York: Appleton-Century-Crofts, 1949.

This new book is a handsome and comprehensive text on general surgical technic. Its author-editor, Dr. Warren H. Cole, presents the work of more than thirty distinguished specialists in addition to his own. Dr. Frank H. Lahey, writing the introduction, points out the constant need of modernization in such textbooks to keep pace with the rapid advancement of surgical knowledge and skill. Research, new diagnostic methods, and the decision for or against operative intervention in the given case are the main areas of emphasis, aside from the detailed presentation of technics.

As the work of specialists in nearly three dozen fields, *Operative Technic* has a peculiar value for specialists and general surgeons alike. To the specialist it offers stimulation to new refinements of technic; to the general surgeon it provides ready and dependable aid in solving problems that lie more or less outside his daily routine.

The book contains more than five hundred illustrations, including some fine color plates. There are twenty-three chapters, each dealing exhaustively and clearly with the surgery of a different part of the body. There are 939 pages of text, supplemented by a well-organized index. The make-up is unusually distinctive. Coming as it does from authoritative sources second to none in the field of surgery, the book should be welcomed and valued by a wide reading audience throughout the world.

**The Autobiography of Benjamin Rush.** Edited by George W. Corner. Published for the American Philosophical Society by Princeton University Press, 1948.

It is altogether fitting that the life story of Benjamin Rush should appear under the auspices of a philosophical organization. As with all great figures in any field of endeavor, the observations and experiences of a man of medical genius carry with them more than appears on the surface; there is always a strong undercurrent of human feeling, emotional excursion and philosophic implications.

Rush wrote his autobiography under the general title "Travels Through Life," which in itself is an indication that he was aware of these deeper meanings, and supplemented it with his "Commonplace Book," a sort of journal in which he preserved such of his experiences and impressions as had intrinsic general interest. Both are included in this well-edited volume, together with innumerable footnotes relating the facts to leading personalities of the day. Every page, therefore, is replete with historical as well as medical and philosophic interest.

Few changes have been made, most of the material in both parts being reproduced word for word as Rush wrote it. In a few instances Rush himself had indicated deletions which he apparently intended to make.

The book is so crowded with anecdotes that it is impossible to give an adequate impression of it in a brief review. From the Commonplace Book a few random excerpts will perhaps best convey the general nature of the man as revealed by his recorded thoughts. It includes a set of heads for a lecture on the origin of evil, in which, apologizing for a slight digression, Rush amusingly admits that he has been accused of "polygamy" in his studies. "But," he adds quaintly, "unlike a plurality of wives, my studies all agree." On Aug. 26, 1797, there appears the following note: "This day gave two Dollars to the keeper of the new Jail to buy watermelons for the prisoners." On Sept. 17, 1801: "Died my old and once valued pupil, Dr. Hall." There is no other comment, doubteless on the principle "De mortuis nil nisi bonum"? Rush is not always so indulgent; in 1804 he records another death: "Died aged 81 Ed. Stiles, worth near 200,000 pounds, a poor ignorant avaricious creature. . . . He seldom paid a debt without being sued for it, Even his taxes were extorted from him by law."

This book is a treasure for the reader. A more colorful personality has seldom graced the biographical scene, and both the immortal Rush himself and his devoted editor deserve our lasting gratitude.

**Handbook of Anatomy.** By George W. Miller. Ed. 9. Philadelphia, F. A. Davis Company, 1948.

Dr. Miller's small classic of practical anatomic information has long been the medical student's standby. Dental students, nurses and artists have also found it useful, as its many editions testify. A new edition, the ninth, now appears, with notable improvements, especially in the illustrations.

In addition to a systematic outline of the anatomy of every part of the body, there is a chapter on surgical anatomy and one on dental anatomy. The book's physical makeup as well as its content has been revised, and to excellent effect.

# Abstract from Current Literature

**The Fallacy of the So-Called Thyroid Capsule.** Philip Thorek. Am. J. Surg. **78**: 133-138 (July) 1949.

No great experience is needed to convince any practicing surgeon that the so-called thyroid capsule, considered as a well-defined structure completely encircling the gland, does not exist. The thyroid is surrounded by fasciae that form a sheath of areolar tissue with definite points of attachment to the gland itself, and specific planes of cleavage exist therein. If the surgeon is thoroughly familiar with the anatomy of the region he can make good use of these cleavage planes in approaching the gland; but there is no justification, either surgical or morphologic, for the idea that the thyroid can be enucleated merely by incising the sheath.

The anatomic arrangement of the cervical fascia has been presented by many anatomists in as many versions, and a certain amount of confusion has resulted. It may be well to indicate here the results of ten years' research and observations at the operating table, dissection and autopsy, any of which can be verified by observation of the living patient. First, however, it is important to clarify certain general principles of fascial arrangement (Fig. 1A) in order that the normal planes of cleavage may not be mistaken for artifacts. Most skeletal muscles, except those which lie upon bone, cartilage, etc., are surrounded by fascial envelopes of tremendous variation in strength; in some instances there is a strong closed investment like a dense sheath, in others there is only a thin layer. When one muscle overlies another, the layer of fascia between them is common to both; according to Meyers and Macpherson this fact is highly important, though too often overlooked. For the purposes of this article its importance is extreme, because the fascia associated with the deep surface of the sternothyroid muscle bears such an intimate relation to the anterior lamella of the pretracheal fossa that in some instances they become fused and are considered and incised as a single structure.

It must be borne in mind that fascia is a living structure, with its own specific responses to stimuli. It is therefore to be included among other structures for accurate identification in a well-planned thyroidectomy.

The fascia colli, or deep cervical fascia (Fig. 1B) may be discussed under these subheadings: (1) the general investing layer, (2) the pretracheal (middle) layer, and (3) the prevertebral (deep) layer. These layers may fuse at the midline, the degree of fusion depending on the divergence of the infrahyoid muscles and on the number and disposition of the anterior jugular veins, which course between the fasciae of the sternomastoid and the sternohyoid muscles.

*General Investing Layer:* This (the superficial layer) is notable for its capacity of splitting and thus enveloping muscles (the trapezius and the sternomastoid). Attached posteriorly to the ligamentum nuchae, it splits at once to envelop the trapezius, at the anterior border of which it reunites, forming the fascial roof of the posterior triangle of the neck. At the posterior border of the sternomastoid it splits again, forming an investment for this muscle also. Again the two layers, reuniting, proceed forward to form the roof of the anterior triangle, becoming continuous with a similar layer on the other side. Above, this layer of fascia is attached to the external occipital protruberance, the superior nuchal line, the base of the mastoid process, the zygomatic arch and the lower border of the mandible. Below, its attachments are to the manubrium sterni, the clavicle, the spine of the scapula and the acromion process. Thus it assumes the form of a circular tube that maintains the structures of the neck in their several places.

*Pretracheal Layer:* The pretracheal, or middle, layer is the most important of the three from a surgical point of view. It occupies the same place as the sternohyoid and omohyoid muscles; the sternothyroid occupies the plane immediately subjacent. The pretracheal fascia, accordingly, invests the sternohyoid and omohyoid muscles, forms a cleavage plane of loose areolar tissue below them and then becomes a fascial sheath or envelope for the deeper-lying sternothyroid muscle. The areolar tissue lying on the deep surface of the sternothyroid muscle is closely related to the lamella of pretracheal fascia that forms the anterior part of the sheath which encloses the thyroid. This arrangement permits surgical use of the normal planes of cleavage in mobilizing the gland. It also proves, obviously, that no single separate capsule encloses the thyroid.

Having identified the sternothyroid muscle and dissected at a point posterior to it, the surgeon automatically breaks through the sheath and exposes the thyroid gland; but, even though he has made the incision at the proper plane of cleavage, he will find that he cannot mobilize the thyroid lobe completely; the lateral attachments of the pretracheal fascia will prevent him. This can best be de-

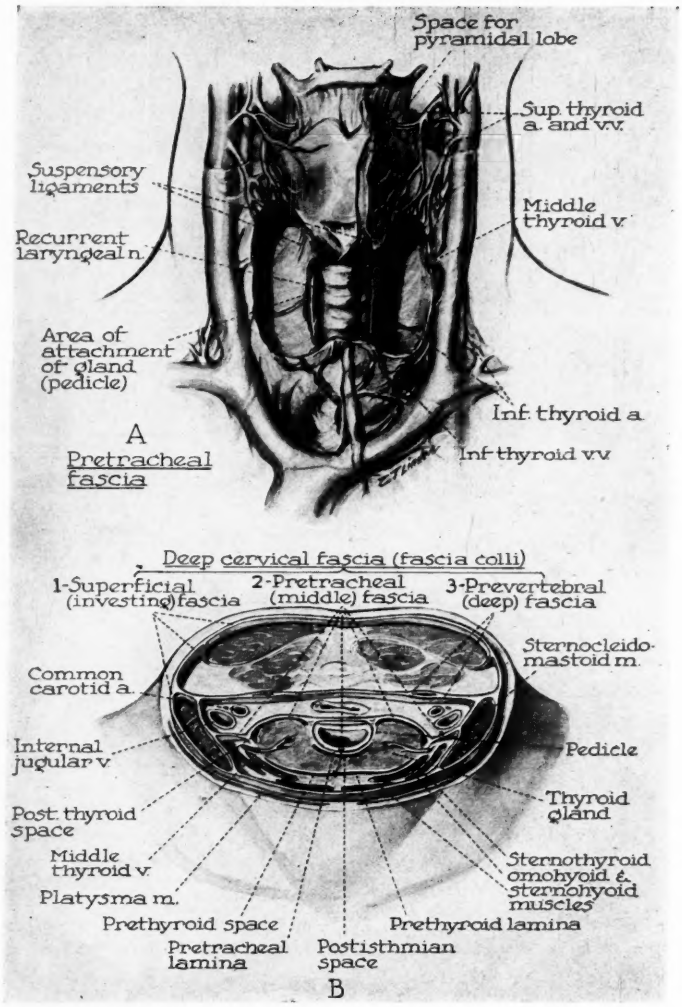


Fig. 1. A, the suspensory ligaments of the thyroid gland shown passing from the inner margins of the gland to the cartilaginous framework. The relation of the vessels and the recurrent laryngeal nerve to the pretracheal fascia is also shown. *B*. Cross section of the deep cervical fascia (fascia colli). Three layers are apparent; the superficial (investing), the middle (pretracheal) and the deep (prevertebral). The important prethyroid and post-thyroid spaces are shown in relation to the middle thyroid vein.

scribed if the pretracheal layer of deep cervical fascia is considered as an offshoot of the general investing layer, passing horizontally in front of the carotid system and, as it continues in a medial direction, splitting into two layers (Fig. 2B): a prethyroid layer and a pretracheal layer proper. The prethyroid layer is a thin anterior lamina extending medially, and loosely attached to the gland along an irregular line at the juncture of the middle and posterior thirds of the surface of the lateral lobe. At the upper pole its course is medial, anterior to the superior thyroid ves-

sels; toward the midline it becomes firmly reunited with the pretracheal layer proper. Another division takes place at the lateral margin of the pyramidal lobe, the prethyroid layer reappearing to extend over the anterior surface of the pyramidal lobe and unite with the pretracheal layer on the opposite side. Below, the line at which the prethyroid fascia is attached to the gland extends around the lower pole and across the inferior margin of the isthmus, where it supplies an anterior envelope for the inferior thyroid veins. Lateral to the gland, this layer is divided from the pretracheal layer proper by a triangular space filled with loose connective tissue (post-thyroid space), whose sides are formed by the prethyroid fascia anteriorly, the pretracheal fascia proper posteriorly and the thyroid gland medially (Fig. 1B). It extends along the posterolateral border of each lateral lobe from the superior thyroid vessels to the lower pole.

The pretracheal layer proper passes medially behind the thyroid lobe, the lateral border of the esophagus and the trachea, where it thickens to form the pedicle of the thyroid gland. Although

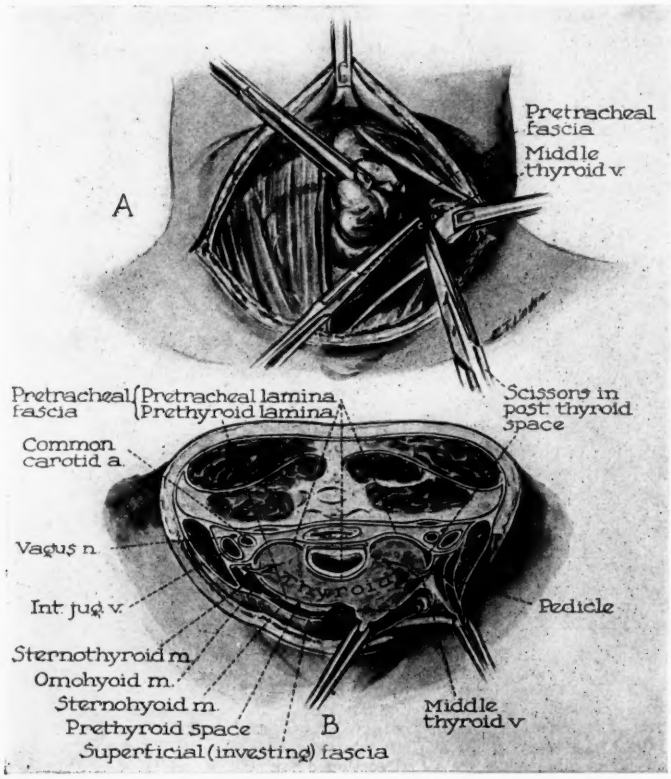


Fig. 2. A, the middle thyroid vein severed and ligated as it passes through the pretracheal fascia. This approach enables the surgeon to enter the post-thyroid space and mobilize the thyroid lobe in the proper manner. *B*. Diagram showing the two laminae (prethyroid and pretracheal proper) of the pretracheal fascia. To the right, the prethyroid space has been entered. The middle thyroid vein divides this space from the post-thyroid space. The prethyroid space is entered immediately by incision of the fascia covering the posterior surface of the sternothyroid muscle and the areolar tissue forming the sheath of the gland; these two tissues are generally in close relation. The post-thyroid space is entered by severance and ligation of the middle thyroid vein and incision of the lateral attachment of the pretracheal fascia to the lateral border of the thyroid lobe.

these posterior and anterior layers of fascia do form a sheath, it is one with several attachments to the gland, which must be clearly understood if the gland is to be mobilized properly. No cleavage plane exists in the region of the pedicle, the attachment here being firm. Extending medially from the pedicle over the trachea and the larynx to join the same layer from the other side, some of its posterior fibers blend with the buccopharyngeal fascia. Areolar tissue separates the fascia anterior to the pedicle, so that a definite plane of cleavage is to be found just behind the thyroid isthmus and the pyramidal lobe.

The two suspensory ligaments, right and left, of the thyroid gland (Fig. 1A) represent thickened portions of the pretracheal fascia passing from the inner margins of the gland to the cartilaginous framework. These ligaments anchor the gland to the larynx in a sort of sling, and the gland cannot be properly mobilized unless they are severed.

Between the layers of the pretracheal fascia are the vessels entering the gland and leaving it (Fig. 1A). The superior thyroid vessels run between the pretracheal and the prethyroid laminae; the inferior thyroid artery, emerging from behind the sheath of the carotid, penetrates the pretracheal fascia in its posterior aspect and passes medially to the thyroid pedicle, where it divides into two or more branches. The inferior thyroid veins and the ima vessels are located inferiorly between these two layers of fascia. Because the parathyroids, the external and recurrent laryngeal nerves and the thymus gland lie in different morphologic planes from the thyroid, they are outside the fascial investments of the thyroid gland proper. In the prethyroid fascia the middle thyroid vein is of greatest surgical importance. This vessel usually leaves the gland at about its middle, following the inferior border of the omohyoid muscle across the carotid artery and ending in the internal jugular vein.

Vertically, the pretracheal layer of deep cervical fascia extends from the hyoid bone above to the fibrous pericardium over the great vessels in the superior mediastinum below, blending with the latter. This layer forms a sheet or plate in front of the larynx and carotid system, in contradistinction to the tubelike circular investment formed by the superficial layer.

*Prevertebral Layer:* This layer has no practical importance in thyroid surgery. Horizontally placed, it is an offshoot of the deep surface of the sternomastoid muscle; it passes behind the carotid system, pharynx and esophagus, but in front of the prevertebral muscles and vertebrae. It extends vertically from the base of the skull to the posterior wall of the superior mediastinum.

## Surgical Considerations

Successful thyroidectomy depends upon two prerequisites: proper exposure and proper mobilization of the gland. Certain steps in the operative procedure, therefore, must be emphasized. The sternothyroid muscle, key structure in locating the "prethyroid space," must be identified. A natural cleavage plane exists between the sternohyoid and the more deeply placed sternothyroid muscle. On entering this space, the sternohyoid muscle can be either retracted or transversely severed at a high level, thus avoiding its nerve supply. The sternothyroid is identified, exposed and retracted or transversely severed. This maneuver incises the prethyroid lamina of the pretracheal fascia which surrounds this muscle, and the prethyroid space is entered. Even then, however, the gland cannot be mobilized, owing to the lateral attachment of the pretracheal fascia to the lobe.

To enter the post-thyroid space it is necessary to separate the prethyroid fascia from the lateral surface of the lateral lobe of the thyroid. This fascia contains the middle thyroid vein, which must be identified, severed and ligated, thus establishing a communication between the prethyroid and the post-thyroid spaces (Fig. 2A). Having entered the post-thyroid space, the surgeon will be able to mobilize the gland and to identify with ease its posterior attachments by its true pedicle.

# In Memoriam

## DANIEL BENJAMIN MARK

M.D., A.I.C.S.

Dr. Daniel Benjamin Mark of Minneapolis, Minn., recently passed away at the age of 61. He received his medical education at the University of St. Louis, graduating in 1909, and then he did postgraduate studies at the University of Minnesota and at the New York Polyclinic Institute. Dr. Mark was a member of the American Medical Association, the Minnesota State and County Medical Societies, and the American College of Physicians and Surgeons.

## GEORGE D. J. GRIFFIN

M.D., F.A.C.S., F.I.C.S.

Dr. George D. J. Griffin, president of the medical staff, Mercy Hospital, Chicago, and noted surgeon, died on his 62d birthday, March 27, 1949. He established medical fame early in association with Dr. John B. Murphy, and in World War I, he headed one of the A.E.F. principal medical centers in France. Dr. Griffin, born in Chicago, was graduated from Northwestern university medical school and interned at Mercy Hospital.

In World War I, he served as senior surgeon at Base hospital 72, Mesves, France, and chief of surgical service, Camp hospital 114, Ecommoy, France.

Since 1919, Dr. Griffin had been on the faculty of Loyola university medical school. At his death, he was clinical professor of surgery there, senior attending surgeon at Mercy Hospital, and also staff president and chairman of the hospital's executive committee. Dr. Griffin was an active member of the American Medical Society, Chicago Medical Society and the Illinois State Medical Society.

## O. CHARLES ERICKSEN

M.D., F.A.C.S., F.I.C.S.

On July 30, 1949, Dr. O. Charles Ericksen, Sioux Falls, S. D., died at the age of 53. Dr. Ericksen received his M.D. at Rush Medical College, University of Chicago in 1920. He served his hospital internship at Mount Sinai hospital, and the St. Francis hospital, Chicago. From 1923 to the time of his death he was affiliated with the Sioux Valley hospital and with the McKennan hospital, Sioux Falls, S. D. Dr. Ericksen was a member of the Seventh District Medical Society, South Dakota Medical Association, American Medical Association, and the Cook County Interne Society, Chicago.

## HARRY H.. EVERETT

M.D., F.A.C.S., F.I.C.S.

The International College of Surgeons, as well as the entire medical profession, mourn the loss of one of its most honored members in the passing of Dr. Harry H. Everett, of Lincoln, Nebr. Dr. Everett, 73 years old, was a graduate of the University of Nebraska in the class of 1897, and continued his studies at Northwestern university where he received his master's degree. He took his postgraduate work at Johns Hopkins University School of Medicine and then went abroad to complete his medical education at the University of Vienna, Austria and the University of Jena, Germany.

Upon his return, Dr. Everett made his home in Lincoln, where he began his varied and excellent career. He was first associated with his father and two brothers at the Lincoln Sanitarium where he served as chief surgeon. Dr. Henry was an instructor at the University of Nebraska, attending surgeon for many years at the Bryan Memorial hospital and St. Elizabeth hospital, and chief of staff of the Lincoln General hospital. .

## LEWIS FREDERIC SMEAD

M.D., F.A.C.S., F.I.C.S.

The Chief of Staff of the Toledo Hospital, Ohio, Dr. Lewis F. Smead, passed away July 28, 1949. Dr. Smead, aged 70, attended Johns Hopkins University School of Medicine, received his degree in 1905, and interned for two and a half years at the Union Memorial hospital, Baltimore. He formerly was a member of the staff of Flower Hospital, and Women's and Children's Hospital and St. Vincent's Hospital, Toledo, O. At the time of his death, he was director of the surgical division staff of the Toledo Hospital.

Dr. Smead made outstanding contributions to the societies in which he held membership, such as the American Association of Obstetricians, Gynecologists and Abdominal Surgeons, and as a member of the Founders Group of the American Board of Surgery.

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